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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 31. 505 PEARL STREET, NEW YORK. No. 22.

Index to Advertisers and Classified Index Following Reading Matter.

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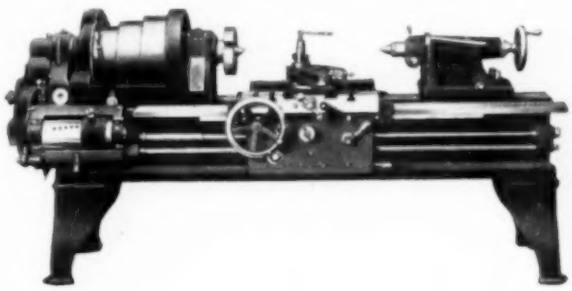

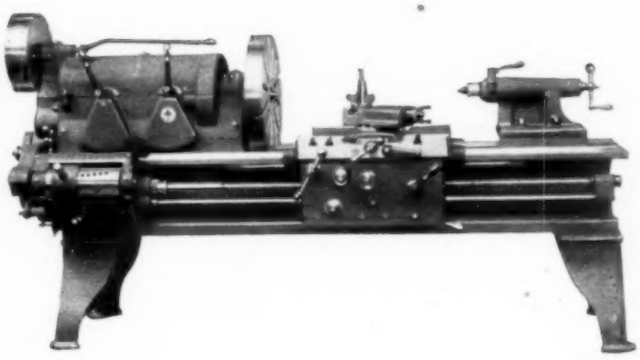

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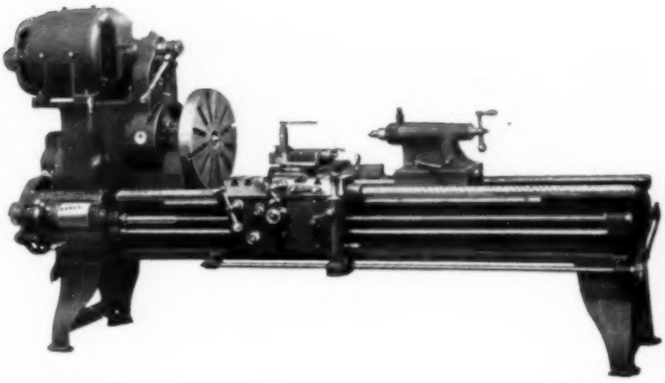

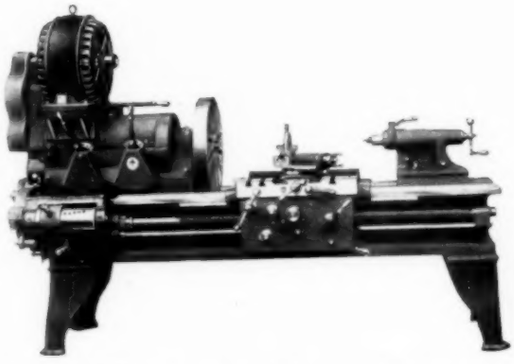

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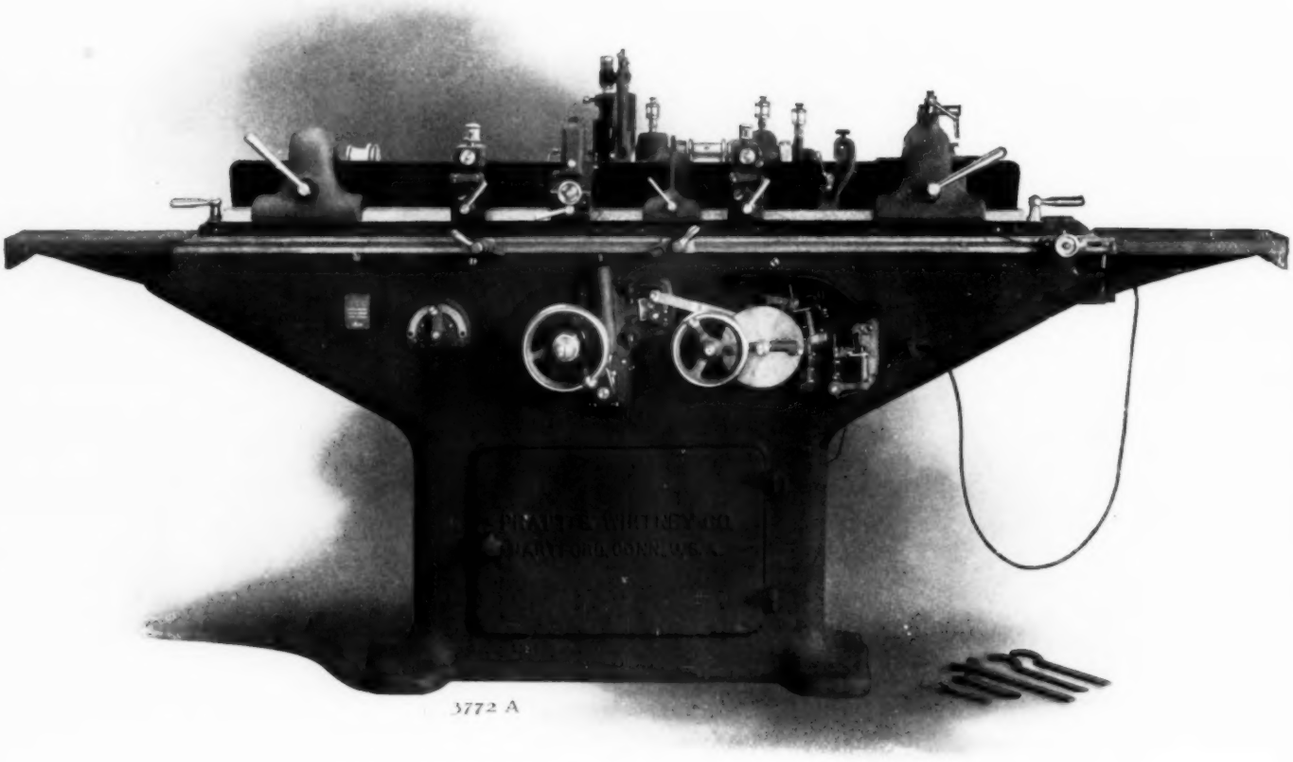

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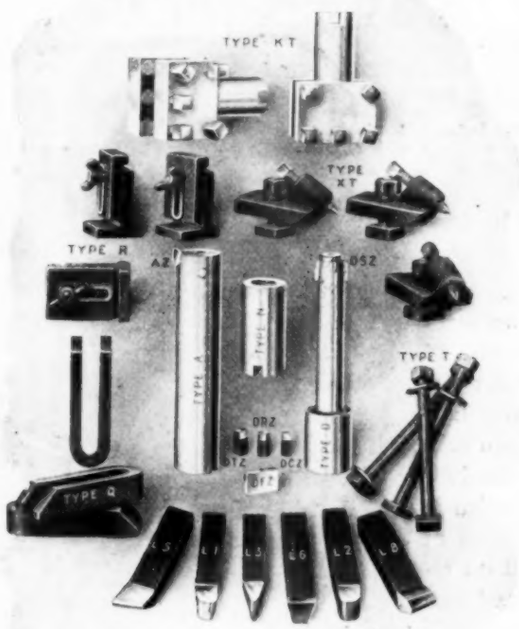

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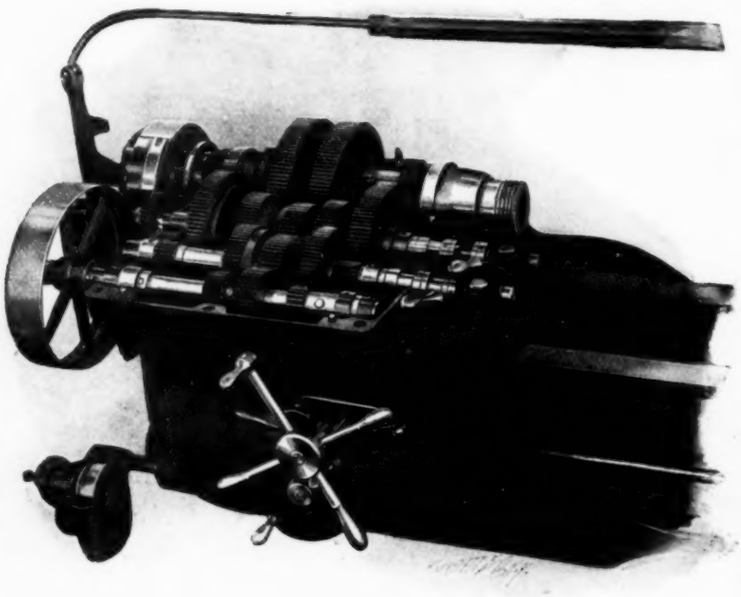

is the Cross Sliding Head (shown here) which combines an ideal scheme of speed regulation with many other desirable features. It allows lower half of all shafting and gearing to run submerged in oil, provides a cross feed for each tool, and has ten stops carried in a revolving holder, which is turned at will by operator. The single drive receives power at a constant speed and in one direction.

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Circular?

DIAMOND MACHINE CO.,
PROVIDENCE, R. I.

New Features in Gas-Engine Construction

Description of a Double-acting Tandem Machine, the Construction of Which Is a Conspicuous Departure from the Conventional Type

BY GEORGE W. MALCOLM

The Watson-Stillman Company some months ago installed in its plant at Aldine, N. J., a gas engine which differs materially from what has come to be regarded as the conventional type of double-acting machine.

The engine operates on gas from a Tryon anthracite producer, and is belted to a three-phase 60-cycle alternator which supplies current to the motors that drive the machinery throughout the works. The engine is a double-acting tandem machine and governs by throttling, and to that extent follows what might be called standard American practice in large gas-engine design. In almost every essential detail of construction, however, it is a conspicuous departure from the beaten track.

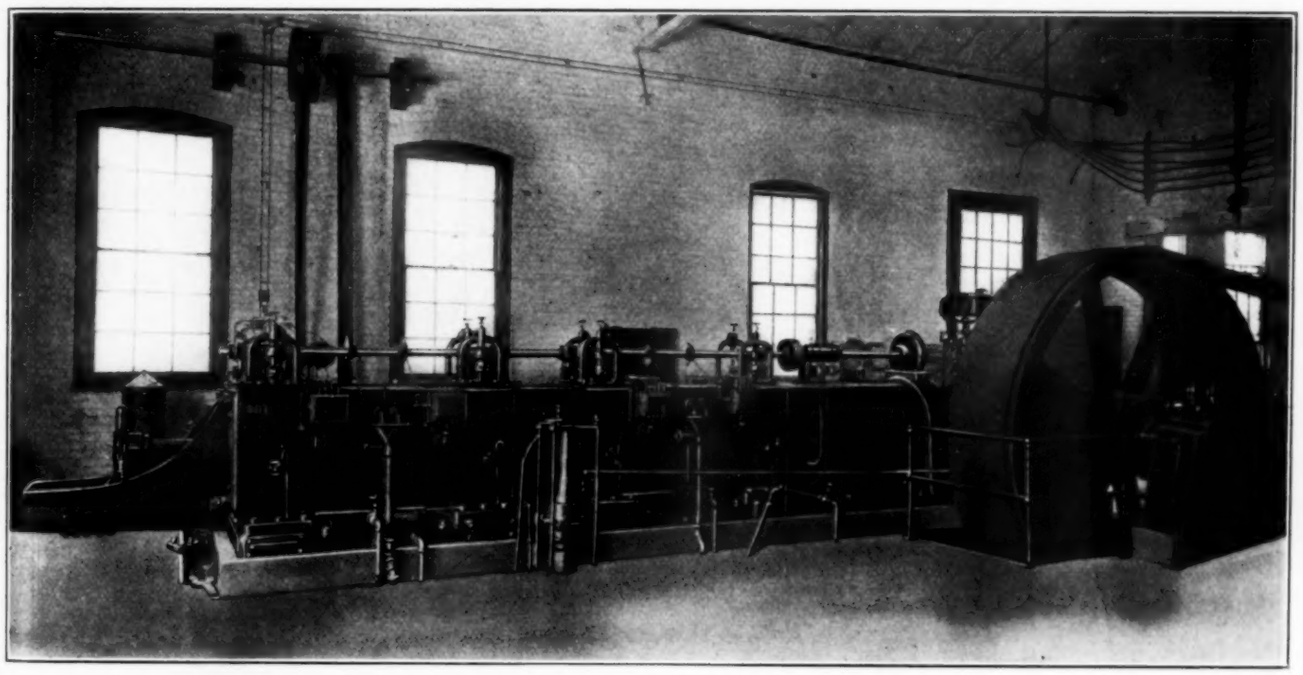


FIG. 1. OPERATING SIDE OF RIVERSIDE GAS ENGINE AT THE WATSON-STILLMAN PLANT, AT ALDINE, N. J.

Main Frame, Cylinders and Sole Plate

The cylinders are made each in two pieces which are fitted together with a tongue-and-groove seam around the middle of the barrel, the joint being metal to metal. The two halves are held together and both cylinders held to the main frame by four steel tie-rods passing through the corners of the cylinder jackets. This method of building is indicated in Figs. 2 and 4; in both of which may be seen the nuts on the ends of the tie-rods, and in the latter, parts of the tie-rods between the parts of the engine. The operating side of the engine is shown in Fig. 1 and sectional views of the cylinder in Figs. 3 and 5.

Each part of a cylinder comprises in one casting half of the cylinder barrel and one cylinder-head, with complete water jacket, the chambers into which the valves are fitted, and the housing of the piston-rod and packing. The lower extensions of the cylinder ends where they rest on the sole plate contain large water spaces in which a large amount of sediment may deposit without interfering with the circulation of the cooling water. Hand-holes are located on the top and bottom of the cylinders and blow-off plugs are screwed into the lower cylinder ends, as illustrated in Fig. 5 so that mud and other sediment may be easily washed out.

This form of cylinder construction results in two or three things of importance. In the first place, there are no joints between the cylinder and the jacket wall which can occasion troublesome leaks. The metal around the cylinder barrel, over the head and the combustion space is of uniform thickness, except where the cylinder barrel is left slightly thicker to allow of reboring. There are no metal bosses to accommodate holding studs, nor surrounding any auxiliary starting valves or tappings. The result is that the compressed charge is surrounded by a metal of uniform thickness without pockets and of probably uniform temperature. The water-cooled valves extend down into the combustion space and assist materially to reduce the temperature of the compressed charge. For these reasons compression can be run extremely high without pre-ignition.

The cylinder ends rest on the sole plate on machine surfaces. From the sectional views, Figs. 3 and 5, it will be seen that the area of contact is not large, but it is finished to be absolutely tight. The cylinders are held down on the sole plate by the plates shown at the sides and are kept in line, but are free to expand and contract longitudinally. The contact joints are made tight enough to withstand the starting air pressure. The sole plate forms a drip-pan under the cylinders, so that all oil is kept from the engine-room floor and delivered to any point desired.

The inlet and exhaust passages in the cylinder ends register with those in the sole plate, and all gas, air and exhaust piping is attached to the sole plate. By slacking the nuts on the tie-rods and taking out the distance pieces between the cylinders, the half of either cylinder may be slid along the sole plate, thus opening the cylinder in the middle, as illustrated in Fig. 4, where the rear half of the front

cylinder is shown slid back to expose the front piston. The distance piece taken from between the cylinders is shown leaning against the rear cylinder.

The whole operation can be done in less time than it takes to remove the nuts from the studs of a bolted-on cylinder-head; no other part of the engine needs to be disturbed, except a union in the small circulating-water pipe, under the cylinder seam. The sole plate is continuous, extending under the entire length of both cylinders and is bolted to the main frame at its forward end.

The main frame is of the rolling-mill type, with bored crosshead guides and main bearings cast in a single piece. A large amount of metal is disposed above the center line of the engine in order to obviate any bending tendency in the frame.

Crank and Crank-shaft

The crank-disk, crank-pin and counterweight are a single steel casting, finished where necessary, hydraulically pressed on the main shaft and doubly keyed. The crank-disk and pin are trued up after the disk is pressed on the shaft.

Two small bosses are cast on the inside of the bed at the level of the center of the shaft and their faces are planed smooth at the same setting in which the bed is planed. Their surfaces are therefore at right angles to the correct position of the axis of the shaft, and the alinement of the shaft may be easily checked by measuring from the faces of these bosses to the adjacent face of the crank-disk.

The bearings on the shaft are ground and of generous size. Liberal fillets are used where there is a change of diameter and there are no square-cornered shoulders.

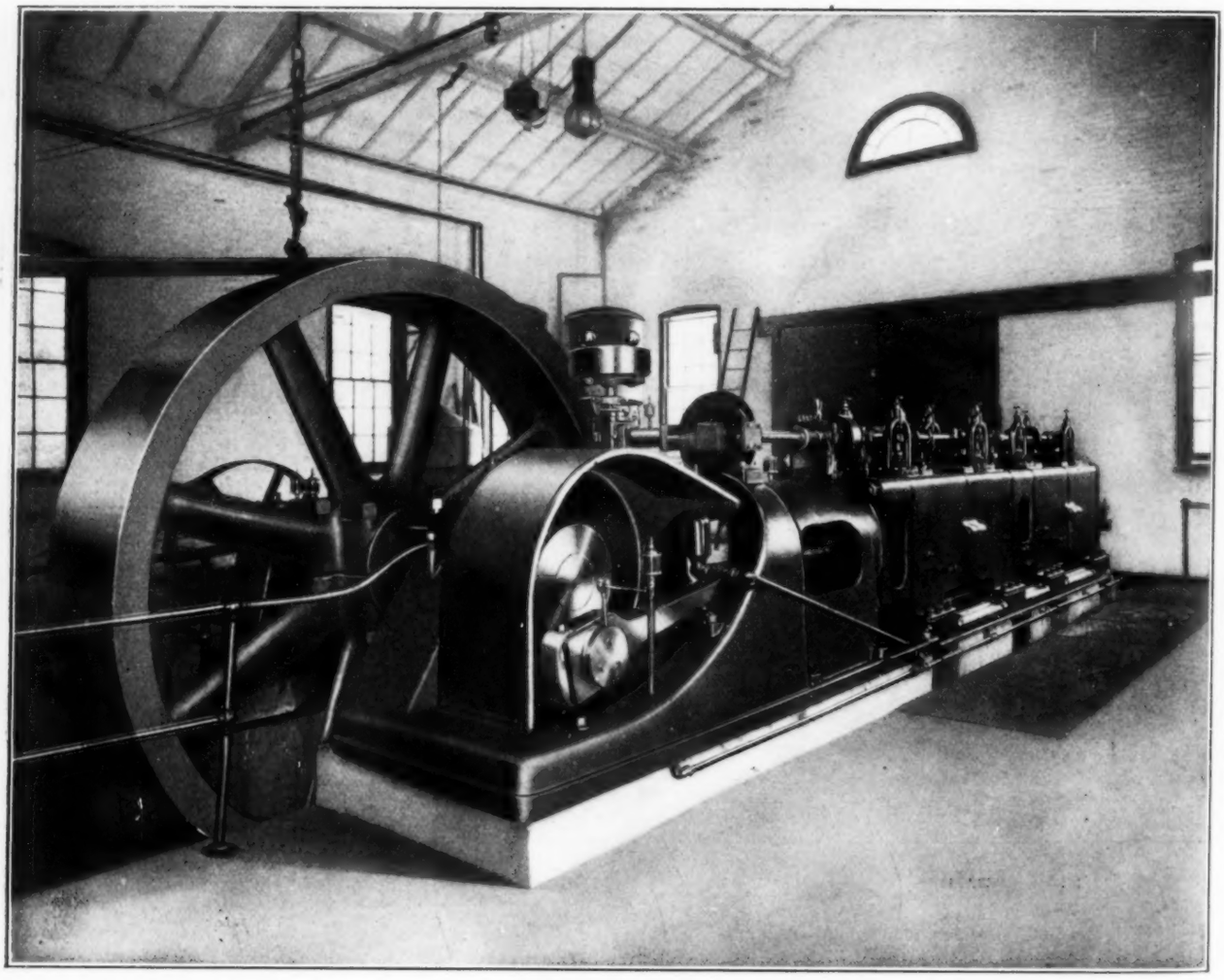


FIG. 2. FRONT VIEW OF RIVERSIDE GAS ENGINE AT THE WATSON-STILLMAN PLANT, AT ALDINE, N. J.

Valves and Valve-gear

Both the inlet and the exhaust valves are balanced and internally water-cooled, and are all of the same size, so that any valve or spare-valve part fits in any place on the engine. Both valves seat at the bottom of the cylinder on opposite sides of the engine axis, operate vertically and are pulled open, as indicated in Fig. 5.

Each valve is of the poppet type and has a hollow-piston extension on the back for balancing. The valve pistons slide in renewable liners set down into the valve chamber, which is cored in the cylinder casting, and are kept tight in the liner by cast-iron snap rings. The bearing surface is very large and forms an excellent guide for the valve; it is force lubricated. The valve-stems of steel are also guided at their extreme ends, and since the valves are pulled open there is no appreciable tendency to "cock" or seat unevenly. The surfaces of the valve guides are entirely out of the "fire" in the cylinder, and this, with the fact that the valves are internally water-cooled, tends to prevent sticking and warping. The valve seats are removable and reversible. They are located below the level of the cylinder barrel, so that foreign substances are readily carried out by the exhaust gases.

The cooling-water travel is shown in Fig. 5. Water is delivered to each cylinder half at the bottom, and thence flows through an internal pipe to the top where the piping branches to deliver water to each valve separately. It flows through an inner brass tube to the bottom of the valve body, out through two slots in the valve-stem, up through the valve and thence between the stem and inner tube to the discharge leg of the water arch.

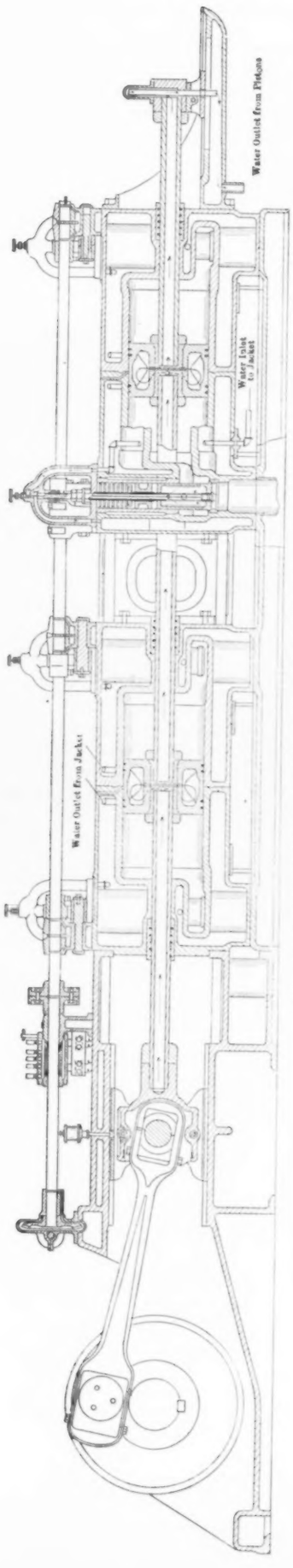


FIG. 3. LONGITUDINAL SECTION OF TANDEM ENGINE AT ALDINE

The barrel water is delivered into the jacket space at the heads at two points by piping from each valve, one point being at the jacket-head just over the stuffing-box and the other at the lower part of the jacket space near the jacket wall, so that cold water is not delivered against any of the cylinder-heads. The amount of water flowing is controlled by small valves at the top of the inner brass tube. The water discharged into the jacket space over the head passes afterward up around the cylinder barrel, and is thence delivered to a visible overflow by a pipe which takes it from the upper part of the jacket space.

By removing the water arches at the top, the valve, liner and all other parts may be removed, leaving nothing but the removable seat in. In removing the valve and liner, not even the cam-shaft need be disturbed.

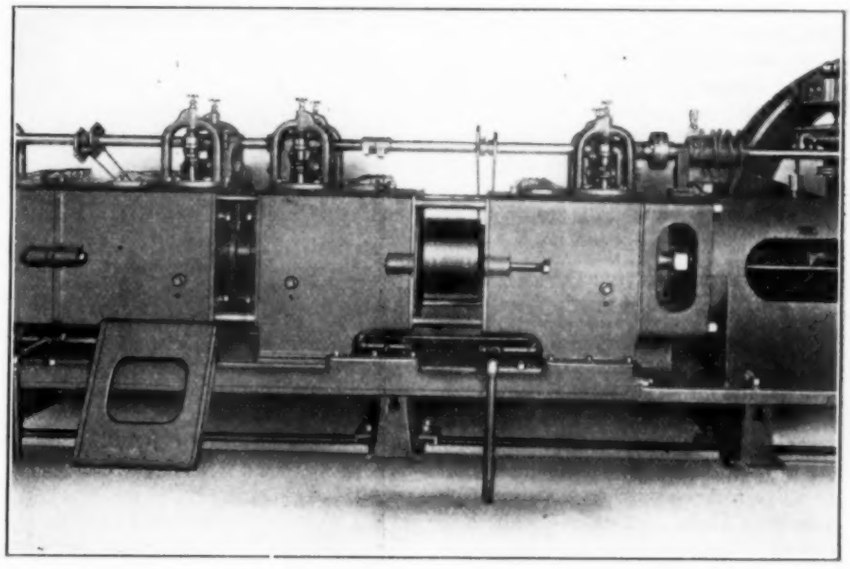


FIG. 4. REAR HALF OF FRONT CYLINDER SLID BACK, EXPOSING THE FRONT PISTON

The valve-gear is unusually simple. The cam-shaft is mounted on top of the cylinders and runs in ring-oiled bearings. This shaft is of uniform diameter and slides through its bearings when any cylinder or half cylinder is moved along the sole plate in opening the cylinders, so that it is not disturbed by the operation mentioned. The cam-shaft is driven from the main shaft by short cross-shafts and machine-cut steel gears running in oil. An inlet and an exhaust valve for each cam are rigidly keyed to this shaft and these cams engage case-hardened steel rollers on the ends of short rocker-arms which lift the valves. This arrangement is shown at the right in Fig. 5. Both the inlet and exhaust rockers for each cylinder end are carried on the same pin and their forked ends have curved upper surfaces which bear against an adjustable collar on the valve-stems. Since the valves are balanced, the gear has only to open them against the gravity force of their own weight and the force of the long helical-closing springs.

Piston and Piston-rod

The pistons are of the box type with a forged-steel core into which the rod ends are screwed until they bottom hard against the partition, as shown in Fig. 6, and held by a jam-nut. The rods and pistons are, of course, water-cooled, the water entering through a telescopic joint connected to the side of the crosshead. Circulation through the hollow rod and the pistons in succession is positive and the overflow device on the tail-rod keeps the pistons always full of water. Since the water passages are drilled at right angles through the piston core, it is impossible for either rod-end to be turned into such position as to restrict the water passages to and from the piston. When cooling water is turned off, the pistons automatically drain to a level below their centers.

Metallic packing is used in all stuffing-boxes. Split segmental cast-iron rings held by a band spring surround the rod and lie in grooves in the box. The box is made in halves, for convenience in assembling around the rod. The boxes are deep and bottom at their inner end. Lubrication is delivered by force-feed between the packing rings.

Ignition

The ignition system comprises a magnetically operated make-and-break igniter for each end of each cylinder, a timer, or circuit-closer, and a source of electric current. Electrodes of each igniter are in series with its magnet coils, which constitute inductances for enhancing the sparks. Each magnet armature is mounted on the spindle of the rocking electrode of its igniter; the igniter points remain constantly in contact except when the timer

closes the circuit of the igniter; then the magnet coils are energized, the armature is attracted, rocking the movable electrode away from the fixed electrode and forming the spark.

The timer is mounted on the cam-shaft ahead of the cylinders, as shown in Figs. 1 and 2. The contacts are of the wiping type, made of tool steel, and are adjustable for wear. A visible indicating spindle shows the amount of contact in each terminal. All of the wearing parts run in oil. The wiring from the timer to each igniter plug is protected by a 5-ampere inclosed fuse; consequently, should any igniter become damaged or short-circuited, it would have no effect on the other igniters.

The time of ignition in all cylinders may be adjusted simultaneously, and means for individual adjustment of the time of ignition in any cylinder end is also provided. All of these adjustments may be made while the engine is running. The individual timing of each igniter allows the ignition to be so adjusted as to give indicator diagrams of equal area from both ends of each cylinder, and thereby correct for inequality due to connecting-rod angularity, obtaining the same effort on the crank-pin at each stroke. Two ignition dynamos, of 110 volts, are provided.

Pneumatic Starting Device and Control

An air compressor driven by a gasolene engine is provided for supplying compressed air for starting the engine, the air being stored in a suitable steel receiver. The pneumatic starting gear consists of two shifter pistons mounted within the valve rocker-arm carrying pins of one cylinder. These pistons are shifted by throwing a small three-way cock which applies compressed air to one side of the pistons, which in turn move the rocker-arms about 5/8 inch, bringing the cam rollers in line with an auxiliary cam which puts all the valves in both ends of one cylinder into two-stroke-cycle action, or, in other words, makes a poppet-valve air engine out of this cylinder. This permits the engine to be started on any stroke or on either quarter. The operation being entirely automatic, the engine will run as long as compressed air is applied. The other cylinder remains unchanged as a four-stroke-cycle gas engine and takes up its explosion after the first revolution. Compressed air is then shut off from the starting cylinder and the three-way cock reversed, which returns the cam rocker-arms to their normal position, and that cylinder immediately goes into regular action. The starting gear adds very little to the mechanism of the engine, as the regular inlet and exhaust valves are used for distributing the air. There are no extra shafts or auxiliary valves and no tappings into the cylinders. There is only one compressed-air pipe leading from the compressor to the sole plate.

On a controlling pedestal are mounted a lever for controlling the free-air supply, the three-way cock, the compressed-air throttle wheel, the lever for controlling the gas supply and the ignition switch. This permits the engineer to start the engine, bring it up to speed and adjust the air and gas to a correct mixture without leaving his position. It is stated that this engine can be started and brought to running speed in one-half the time and just as easily and just as positively as a steam engine of similar size. The engine was built by the Riverside Engine Company, of Oil City, Penn.

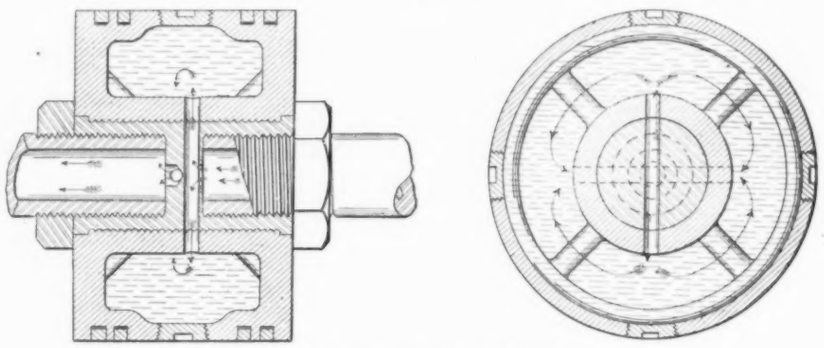


FIG. 6. CONSTRUCTION OF PISTON

The United States exported 331 automobiles in January and February, which, with parts, were valued at $790,016. In the corresponding months last year 427 autos were exported, the value, with parts, reaching $820,170. The exports exceeded the imports by $327,143, and to Great Britain there was an increase in exports to the value of $156,000, as compared with the French loss of $374,000.

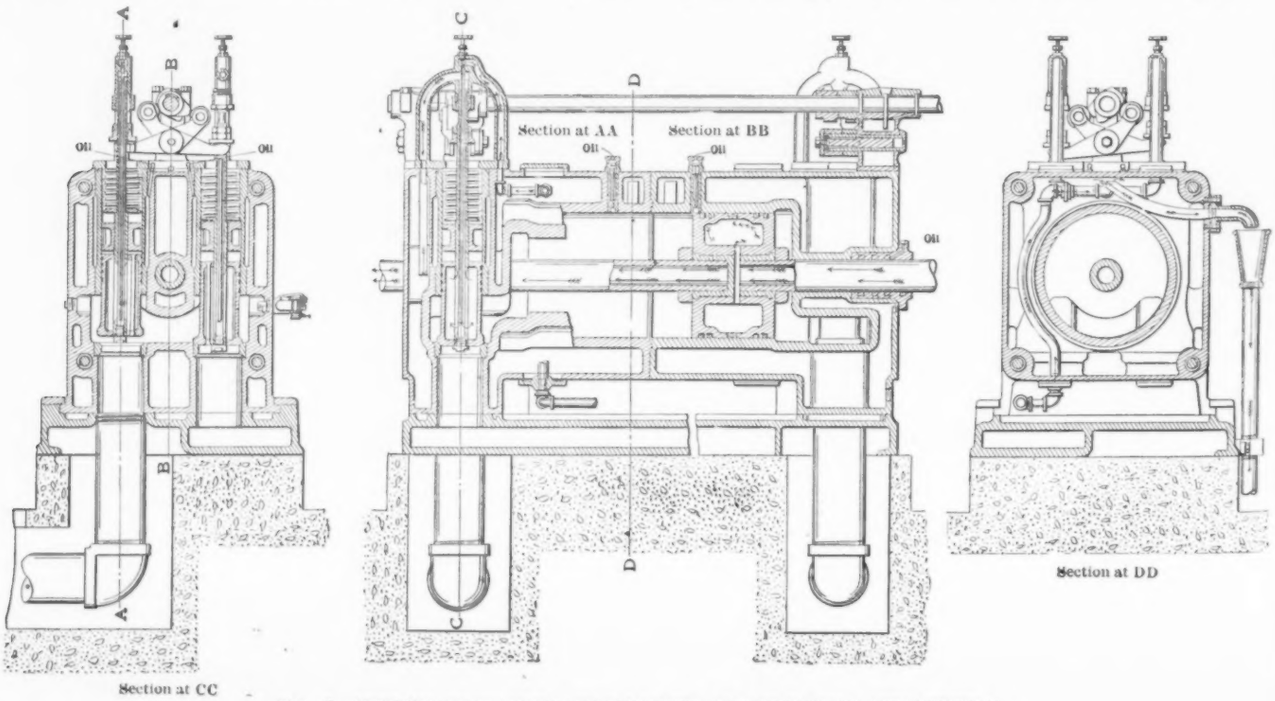
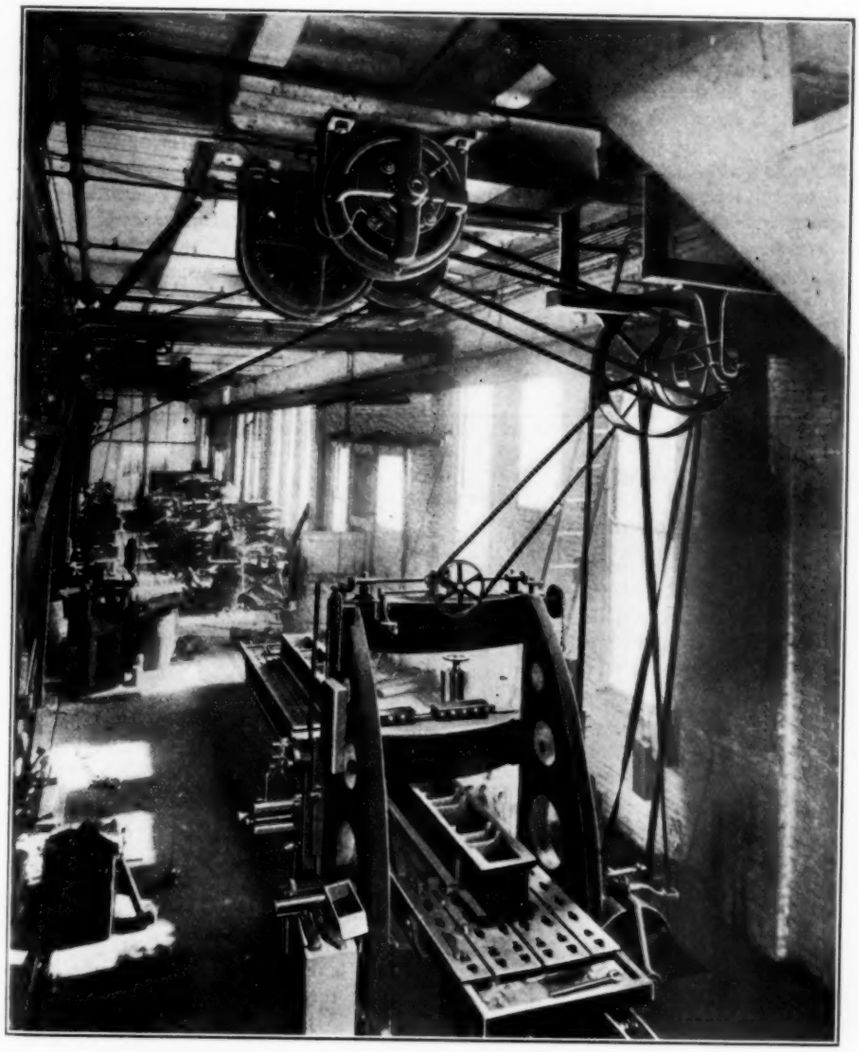


FIG. 5. SECTIONS OF CYLINDER, ILLUSTRATING ALSO THE VALVE ARRANGEMENT

A Two-motor Variable-speed Planer

The accompanying illustration shows a 54-inch by 26-foot Niles planer at the works of the R. K. Le Blond Machine Tool Company, together with a method of driving it which has been adopted for all of the large planers at the works. The system comprises the use of separate motors for the cutting and return strokes, the former being driven by a variable-speed motor, while the latter is driven by a constant-speed machine, both of the General Electric Company's make.



A TWO-MOTOR VARIABLE SPEED PLANER

The motors are clearly shown suspended from the ceiling, the one nearest the observer driving the planer during the return while the farther one drives it for the cutting stroke. Beyond the second motor is a third smaller motor which, however, has nothing to do with the planer, but drives another countershaft at the left.

Referring to the countershaft of the planer, the pulley nearest the observer which is belted to the return-stroke motor is keyed to the shaft as is also the large pulley at the far end which drives the planer during the return. The intermediate pulleys which perform similar functions for the cutting stroke are attached to a sleeve which runs freely on the countershaft, the cutting and return movements being thus made independent. The return speed is constant at 100 feet per minute, while the cutting speed is variable between 13 and 39 feet per minute. The accompanying table gives the results of a recent power test.

An obvious feature of the system is its applicability, with a trifling change in the countershaft, to existing planers.

	Cutting Speed.	Volts.	Amp.	H.P.
Countershaft and motor empty	Slowest	222	5	1.49
	Fastest	222	10	2.97
Counter, motor and table empty	Slowest	222	8	2.38
	Fastest	222	14	4.17
Reverse *from* return to cutting	Slowest	222	20	5.95
	Fastest	222	30	8.93
Cutting 37 feet, 2 tools Cut ¼x¾ each tool Material C.I. lathe bed		222	.60	17.87

CUTTING STROKE DRIVEN BY 20 H.P. VARIABLE SPEED 3-1 GENERAL ELECTRIC MOTOR. CUTTING SPEEDS 13-39 FEET.

	Table Speed.	Volts.	Amp.	H.P.
Countershaft and motor	100 feet	223	14	4.18
Counter motor and table	100 feet	222	72	20.03
Reverse *to* Return stroke from slow-cutting speed		222	100	29.75
Reverse *to* Return stroke from fast-cutting speed		222	105	31.25

RETURN STROKE DRIVEN BY 25 H.P. CONSTANT SPEED GENERAL ELECTRIC MOTOR. RETURN SPEED 100 FEET PER MINUTE.

Using the Advertising Section

BY PAUL W. ABBOTT

Upon asking some of my friends around in the shop and some of my own men why they don't read the AMERICAN MACHINIST, I often got the answer: "O, there's nothing in it but ads. I can't afford to pay 10 cents a week to look at those."

We, who know what a help the paper is to us, realize the falsity of such ideas, and I am writing this in the hope of showing the use of the advertising section to the ordinary mechanic, not mentioning the good meat in the magazine proper.

One of the good things are the catalogs and treatises one can obtain from the different manufacturers who advertise there, containing valuable tables of information not found in handbooks, and advice as to the operation of their machines, which is a valuable feature to any mechanic. The best book of tables and formulas on figuring gearing I ever saw was sent free to me by a manufacturer, on application as to how I could obtain it.

Another valuable feature, particularly so to milling-machine men, are the advertisements of a certain well known milling-machine manufacturer which always consist of a clear photograph of some interesting piece of work being milled, and all the necessary data of the job, speed, feed, kind of cutter, etc. One of the younger members of the family for a slight sum would be delighted to go through the back numbers and pick these out.

I have had mine looked over and have bound them together so that I possess about a hundred clear-cut descriptions of modern milling-machine operations, with full data, and another important feature of these is that they are actual photographs showing how the work should be properly held while taking the cut.

Another firm building screw machines has a good line of advertisements which I am now collecting, showing the work and the cost of production. In my own case in our screw-machine department we have four of these machines and thought our men were getting out a good production, but on comparing our results with these advertisements I saw where conditions could be improved and production on those four has taken a jump of about 25 per cent.

An Engine Lathe with Many Novel Features

A Lathe Which Shows Originality in Design from the Absence of a Nose on the Spindle to the Location of the Feed Rack

EDITORIAL CORRESPONDENCE

The accompanying photograph marked as Fig. 1 shows a new engine lathe, which is full of new features in lathe design, recently brought out for using high-speed steels to their fullest capacity. Often a lathe of about 24-inch swing is used to furnish sufficient pulling power when turning a 6-inch shaft, but the machine shown herewith is designed to have ample power for all diameters within its swing. Numerous special high-speed machines have been designed for this purpose, but it has been the aim in the design of this tool to supply a general purpose machine with all conveniences common to the ordinary engine lathe, and at the same time with sufficient power and rigidity to handle as heavy a job as the lathe will swing.

As evidence of the general character of work which can be done on this lathe, the makers have produced a sample pedestal and some other specimens which are shown herewith. The gray-iron flange or pedestal shown in Fig. 2 is 14½ inches in diameter at its base by 1½ inches thick. A cut has been taken on the periphery of this plate when running at 50 feet per minute and using 1/16-inch feed, the reduction in this case being 11/16 or 11/32-inch depth of cut. On the upper face of this plate are chased three scrolls, the outside one being a left-hand, six per inch, the middle one a right-hand, three per inch, and the inner a left-hand of four per inch. Beginning at the face of this plate, where the pedestal joins the flange, a 4-inch taper per foot is turned; above this, a reverse taper of same amount, and over this a half-inch taper per foot. Next a square thread of two-per-inch pitch, and more clearly shown in the photograph marked as Fig. 3. The square threads in this case were rough-chased by the rack-feed, after which the half nut was thrown in and the threads finished part of the way down with the lead screw. This gives an idea of the use of the rack-feed in rough-chasing the threads and shows how the screw is relieved while doing rough-chasing. A hole in the gray-iron pedestal is chased with a left-hand U. S. Standard thread, 2-inch taper per foot, to receive the steel bar at 4. This steel bar contains 19 threads, ranging from seven per inch to 32 per inch. The top of this bar is bored for No. 3 Morse taper, and is joined at 3 to a second steel stem which is fitted into it. The second stem contains 15 threads from 36 per inch to 112 per inch. A nurled nut has been chased with 112 V-threads per inch to fit the extreme top of the second stem, and is designated as 2. The stem at the top is ½ inch in diameter. Mounted on the extreme top of the pedestal is a tool-steel screw 9/32 inch in length over all, 0.105-inch diameter at body of thread, and 0.175-inch diameter of head. This screw is chased 32 threads per inch and of special form of thread to screw into the spring of a Brown & Sharpe test indicator.

Some contend that it is impossible to take smooth cuts while driving through gearing, and that smooth finishing cuts can best be produced while driving direct with the belt speeds, and also that it is not possible to machine a surface smooth if the machine is slowed down or stopped while making speed changes. To disprove this, the bottom part of the plate of the gray-iron pedestal was faced at 1/16-inch feed, Fig. 4, and the speed was changed eight times during the cutting and the job was turned while the spindle was being driven entirely through gearing. The photograph shows the tool marks plainly, but it does not show any unevenness caused by the gear teeth.

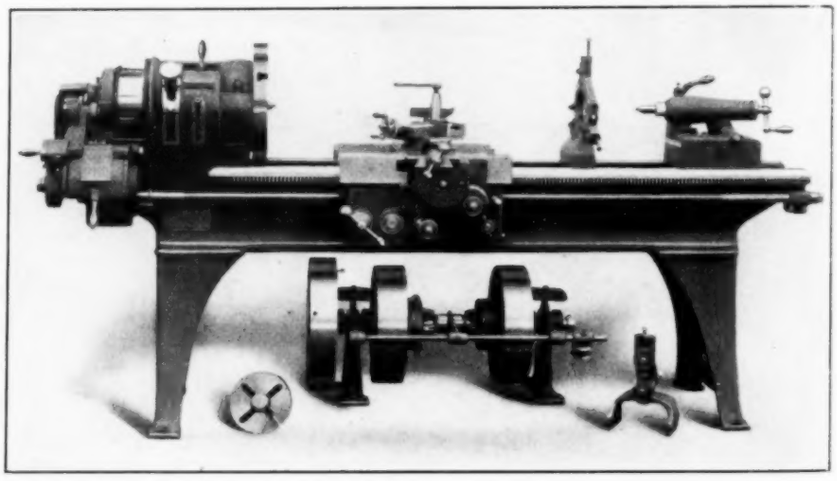


FIG. 1. THE NEW ENGINE LATHE

Among the novel features is a driving pulley mounted direct on the headstock spindle, which can be locked to the spindle as is the case with the ordinary cone pulley machine when driving with open belt, and this method allows for a number of open-belt speeds with the use of a speed variator overhead, provided it is deemed desirable to use this method of driving. The headstock, however, is provided with 16 changes of speed when the pulley upon the spindle is driven at a constant speed and the design of the headstock and the bed are such that either a direct or alternating motor may be attached without changing the design or supplying a different style of headstock.

There is an index within the headstock telling the operator the exact diameters which can be turned at various cutting speeds ranging from 20 feet to 60 feet per minute and he need not know the number of revolutions per minute of the spindle, but deals entirely with the diameters of the work in hand when the index is set for certain cutting speeds in feet per minute.

The quick-change mechanism covers a range of threads from 2 to 112 per inch, and the entire mechanism is self-contained within a single housing and secured to a pad on the bed. The carriage feeds are in the same ratio and in the same direction as the screw feeds. The cross-feed screw is also in the same ratio as the lead screw, and the index for longitudinal threads also applies to the cross-feed screw for chasing scrolls.

A form of taper attachment is used which permits turning tapers from zero to 4 inches to the foot, and this taper attachment is applied directly to the face of the apron and can be attached at any time after the machine is installed. Every adjusting screw throughout the machine and countershaft can be operated by the tool-post wrench.

The Headstock and its Gearing

Fig. 6 is a sectional plan of the headstock and shows the driving pulley *A*

mounted upon and keyed to the steel sleeve gear *B*, which is bronze bushed and revolves loosely on the spindle *A*-1. The gear *B* has a cone of gears *C* splined to slide upon it which are provided with the clutch teeth *D*. The clutch *E* is keyed to the bronze sleeve *E'*, which also revolves loosely upon the spindle. The gear *E*-2 is splined to slide longitudinally upon the sleeve *E* and is equivalent in action to the cone pinion of the ordinary engine lathe. Gear *E*-2 meshes with the gear *E*-3, which is splined to the sliding pinion *E*-4 located in the bearing on the front side of the headstock. This meshes with a steel face gear *A*-2, which is counter-bored and threaded to receive the face plate *A*-3. The face gear *A*-2 is mounted to the flange of spindle *A*-1 and these parts are held together by dowel pins and screws. It will be seen that the web of the face gear *A*-2 extends down back of the flange of the spindle *A'*, and that when the face plate *A*-3 is screwed into the face gear, the gear *A*-2 and the spindle *A'* have a tendency to clamp tightly. The nose of the spindle *A*-1 extends out and is made to fit the bore of the face plate *A*-3 for centering it, and the threads within the face gear *A*-2 are made to fit loose so that the truth of the face plate will not be affected by any inaccuracy that may occur within the thread. By mounting the pinion *E*-4 on the front side of the head, it will be seen that all the pulling power will be downward and on the front side of the center where the tool is always operated. This construction reduces the overhang of the chuck and the face plate. The threads within the face gear *A*-2 are made about the same diameter as the counter-bore in the back of the ordinary chuck for a machine of this swing, and in fitting a face plate for a chuck it is only necessary to bore out a blank plate to fit the nose of the spindle and chase an external thread on this plate leaving a portion to be fitted into the chuck. This method of driving the chuck and face plates eliminates all torsional stresses within the spindle when driving on all diameters employing the use of a high gear ratio, as the gear *A*-2 is practically a part of the chuck.

Referring again to the spindle *A*-1, it will be seen that the clutch teeth *A*-4 are formed upon the spindle, which teeth engage corresponding teeth or keyways within the sliding gears *E*-2. When the sliding gear *E*-2 is moved to its farthest position to the left, it is locked rigidly to the spindle, but this movement cannot take place until the gear *E*-4 is out of engagement with the face gear *A*-2. This drives *E*-2 direct at its maximum speed and not through the gearing. By disengaging *E*-2 from the spindle and engaging *E*-4 to *A*-2, the drive will now be through what would ordinarily be called the back gear, but which on the index plate giving the list of speeds, is termed "low gear," meaning the gear of the lowest speed. By the manipulation of the gear *E*-2 and the pinion *E*-4 the use of the high and low gears are available. Gear *E*-3 has an internal gear *D'* secured to it into which the pinion stem *D*-2 meshes. This pinion stem is made of tool steel, revolves in a bronze bushing, and has the gear *D*-3 mounted at its left end. The telescopic gear *D*-4 is provided to be mounted over the gear *D*-3 and to impart motion to the pinion stem *D*-2 at a different speed. The pinion stem *D*-2, is confined within a housing *D*-5, mounted on the casting *F* which forms the front portion of the headstock. This housing can be rotated by the extension *D*-6 in Fig. 7. The telescopic gear *D*-4 may be engaged with any one of the cone gears *C* on the sleeve pinion *B*, or the gear *D*-4 may be removed and *D*-3 engaged with any one of the cone gears *C*, but not with the sleeve gear *B*. This allows the gear *D*-4 to be driven at four different speeds and the gear *D*-3 to be driven at three speeds, making seven in all, and when the clutch *D* is engaged with the clutch *E* and both of the gears *D*-3 and *D*-4 are thrown out of engagement the eighth speed is obtained. These speeds are all geared by using the high or low gear as before mentioned.

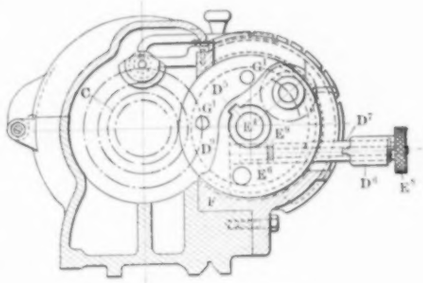
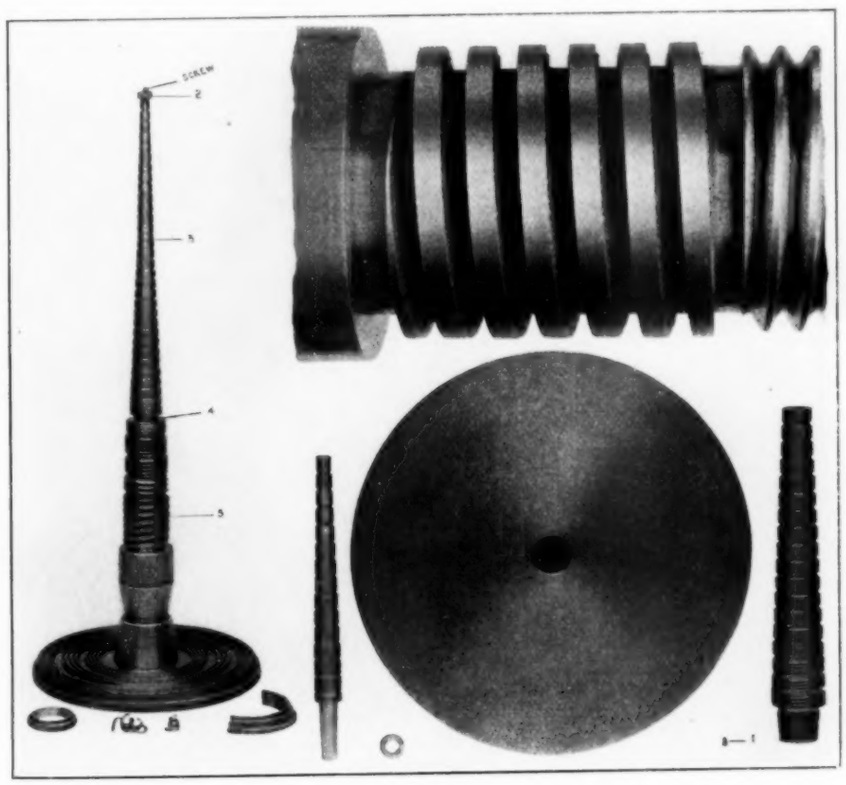


FIG. 5. SECTION THROUGH HEAD

The housing *D*-5 is cut out as shown at *D*-9, Fig. 7, to permit the clutch *D* to be engaged, and when such is the case, the housing cannot be moved sufficiently to engage the gears *D*-3 and *D*-4 with the cone of gears *C*. To avoid the gear *E*-2 being engaged to the spindle at the same time that the pinion *E*-4 is engaged to the face gear *A*-2, the method shown in Fig. 7 is employed. The sliding pinion *E*-4 is journalled at its left end in a bronze bushing *E*-5, which has rack teeth milled in it to engage the pinion stem *E*-6, Fig. 5. This pinion stem takes its bearing in the steel sleeve *E*-7 which fits into the rotating housing *D*-5 previously referred to. The sliding detent collar *D*-6 is mounted over the sleeve *E*-7. The pinion stem *E*-6 is spring seated at *E*-9 to holding the detent collar *D*-6 into the notches milled into the face of the casing *F*. It will be seen that the nurl *E*-8 may be turned in either direction for sliding the driving pinion *E*-4, and that it may be moved radially to adjust the housing *D*-5. This housing has a sliding sector *G*, Fig. 6, mounted upon and around the pins *G*-1 and the sector *G* is grooved to receive the flange of the sliding pinion *E*-2 on the spindle sleeve.



FIGS. 2, 3 AND 4. SAMPLES OF WORK TURNED AND THREADED

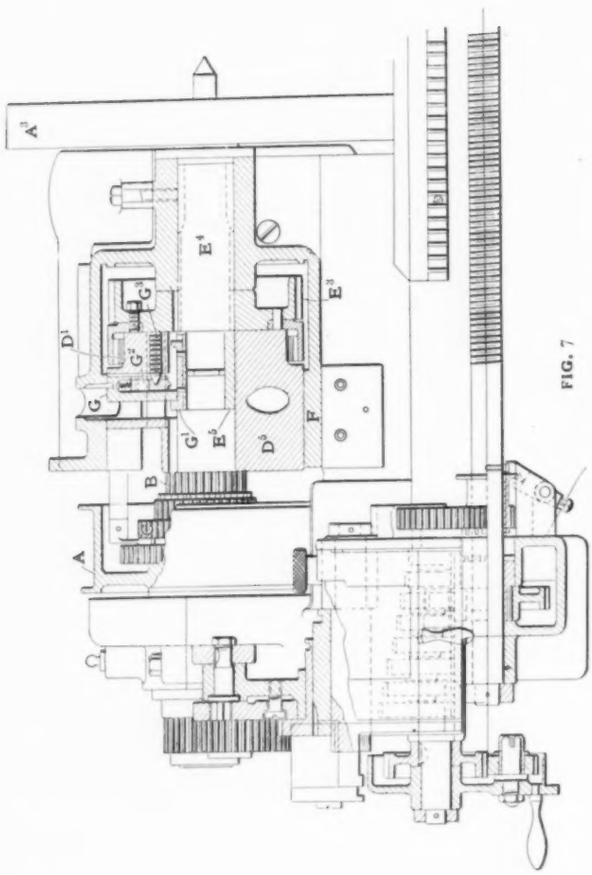


FIG. 7

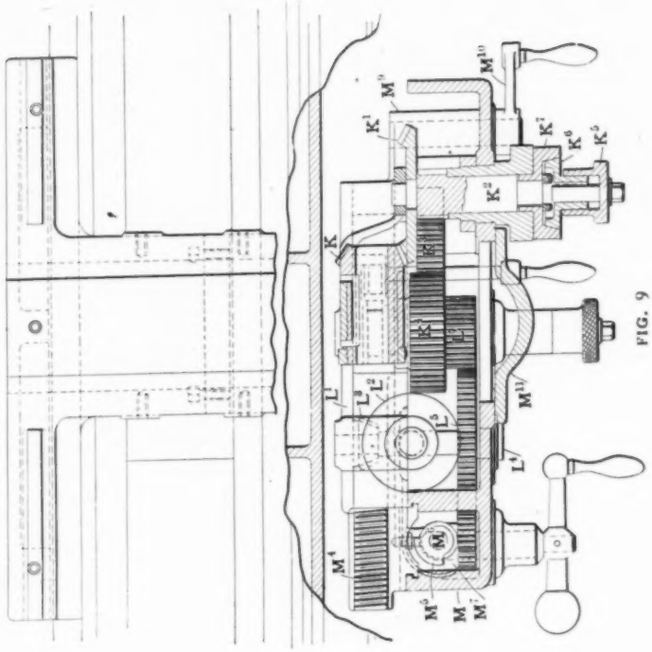


FIG. 9

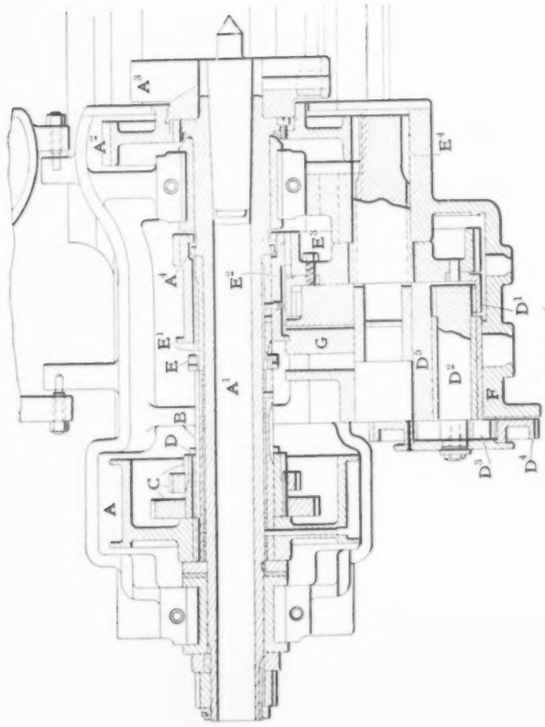
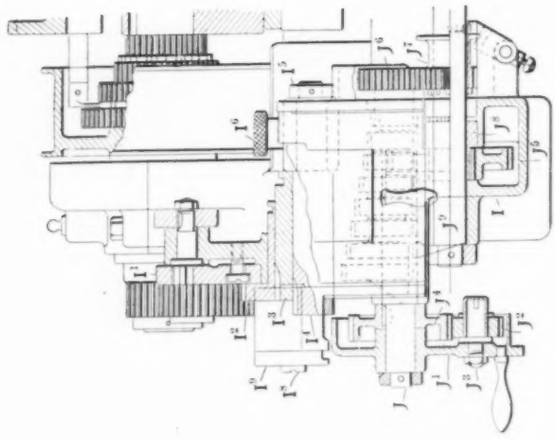


FIG. 6



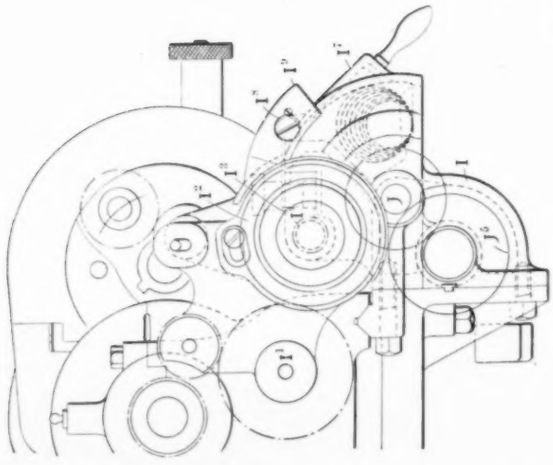


FIG. 8

DETAILS OF NEW LATHE

The longitudinal movement of the sector *G* transmits movement to this pinion regardless of the position of the housing *D*-5 and the longitudinal movement of the sector *G* is accomplished by the movement of the bronze bushing *E*-5, which is provided with a specially formed key *G'* serving as a dog or tappet. When this key, *G'*, Fig. 7, is moved to the left, the tappet upon this key strikes the sector *G* and moves it sufficiently to engage the clutch of the pinion *E*-2, Fig. 6, to the spindle and at this period a spring-seated latch *G*-2 confined within the sector *G* engages the extension on the key *G'*. At this position the machine operates in the high gear, the pinion *E*-4, of course, being out of engagement with the face gear. When it becomes necessary to engage the low gear, the nurl *E*-8 is turned to the right as indicated by the arrow stamped upon it and the sleeve *E*-5 in its movement to the right will move the sector *G* through the latch *G*-2 until the pinion *E*-2 upon the spindle is disengaged with its clutch. At this point the sector carrying the latch is moved sufficiently to engage the counter-sink of this latch with the screw *G*-3. This engagement raises the latch and allows the key *G'* and the sleeve *E*-5 to move past and so the pinion *E*-4 is engaged to the face gear *A*-2.

To Secure Any Cutting Speed

An index arrangement is mounted on the front side of the casing and carries a pointer which is secured to *H'*, operating the movement of the cone gears upon the spindle pulley. The position of the pointer is determined by the notches milled into a bracket secured to the casing. An opening is cored into the front of this casing and an index plate mounted within it for giving the correct diameters to be turned at the various cutting speeds in feet per minute. The horizontal columns of the index plate give a list of the diameters to be turned at cutting speeds from 20 to 60 feet per minute; the horizontal columns being headed by the words "Diameter of work at 20 feet per minute," etc., and the vertical columns of this plate correspond with the vertical columns of the plate which designates the position of the pointer. The opening of the casing *F* is only large enough to expose such figures as are found under one heading of "Diameters of Work" at 20 feet per minute, etc., but the index may be adjusted by the nurl below the pointer to expose any one of the columns showing the cutting in feet per minute. Suppose it is desired to turn a 12-inch gray-iron gear at 40 feet cutting speed per minute. The index plate is moved by the small nurl in front until the figures headed "Diameters of work at 40 feet per minute" are exposed. The pointer above is now brought to the column giving the nearest diameter to 12 inches, which in this particular case is 12¼ inches. This calls for low gear to be used, and the plate attached to the top calls for change gear 67. The change gear of this index refers to gears *D*-3 and *D*-4 of Fig. 6. The diameters, as shown by the index, which can be operated on at 40 feet per minute are as follows: 13/32, 9/16, 11/16, 15/16, 1 3/16, 1½, 2, 2 9/16, 3⅜, 4½, 5¾, 7½, 9½ and 12¼ inches, making 15 in all. The sixteenth diameter is omitted as it is larger than the lathe could swing.

Openings are cored in the bed to permit the use of a belt or silent chain drive from a motor mounted underneath the headstock. The headstock is provided with a hinged cover and when it is desired to mount the motor above the headstock, a platform is substituted to receive the motor in place of this cover. On account of the great number of gear changes within the head, it is not necessary to use a variable speed motor as the increment of mechanical speed change does not exceed 28 per cent., making it very easy to use an induction-motor drive.

Quick Changing of Gears

Fig. 8 shows a new form of quick-change device which is entirely self-contained. The housing is bolted and tongued to the pad upon the bed and has a bearing for supporting the reverse plate *I*. This carries the transmitters or intermediate gears for giving the forward and backward motion to the feed, these being guarded by a suitable cover. The reversing is accomplished by a small eccentric and nurl which is confined in an extension to this housing. Power is transmitted from the spindle gear to the telescopic gear *I*-2 the face of which is one-half that of the transmitters. This telescopic gear takes its bearing within the housing concentric with the pivotal point of the reverse plate *I'* and is splined to slide through this bearing upon the telescopic gear *I*-3. The gear *I*-3 is splined to slide upon the gear *I*-4 and these three gears are the driving members of the quick change. It will be seen that the gear *I*-4 extends beyond the face of the telescopic gears *I*-2 and *I*-3 equal to the width of the change gear, and has no endwise movement but is confined longitudinally within the bearing of the housing *I* by the collar *I*-5. The telescopic gears are moved longitudinally by an eccentric in the nurl *I*-6 in order that they may be brought in alinement with the change gears or flush with the gear *I*-4.

A second shaft *J* takes its bearing in the housing and carries a quadrant *J'* which quadrant supplies what is ordinarily the intermediate gears *J*-2 of the plain change gear lathe. This gear is mounted on the bronze sleeve and takes its bearing on the stud *J*-3. Gear *J*-2 meshes with the gear *J*-4 which is keyed to the second shaft *J*. The second shaft *J* has a pinion milled into it meshing with the gear *J*-5, which is keyed to the clutch *J*-8, and loosely journalled upon the lead screw bearing within the housing *I*. The shaft *J* also has gear *J*-6 keyed to it at its right end and this gear meshes with the sliding gear *J*-7 which is splined to slide upon the lead screw *J*-9. The clutch *J*-8, previously referred to, receives the teeth of the clutch which is formed upon the sliding gear *J*-7 and the face of *J*-7 may be thrown out of engagement with that of *J*-6 and the lead screw locked to revolve with the gear *J*-5. This makes an 8 to 1 reduction to the index.

An opening is provided in the housing *I* to receive the eight steel change gears, all of which are provided with a three-tooth clutch at their hubs. These change gears are covered by a swinging plate *I*-7 which plate is tapped left hand to receive the screw *I*-8. This screw extends through the clamp *I*-9 so that when the plate *I*-7 is brought up exposing the change gears, the clamp *I*-9 is released and when brought down the clamp is tightened, locking the quadrant *J*-1 firmly in place. The gear *J*-2 which revolves on the stud *J*-3 is mounted on a bronze sleeve and the outside diameter of this sleeve fits the bore of the change gears. The gear *J*-2 has clutch teeth to mate those of the change gears so that any selected one of these may be secured to it. When it is necessary to make a change of feed the plate *I*-7 is raised and the quadrant *J*-1 thrown down in the position shown on the drawing. The change gear is now clutched to the gear *J*-2 and the quadrant *J*-1 brought up until the change gear meshes with any selected one of these three gears *I*-2, *I*-3 or *I*-4. The eight change gears when driven by the three gears referred to, cut all threads from 2 to 14 per inch when the lead screw is driven through the gears *J*-6 and *J*-7, and the same combination of gears will cut threads from 16 to 112 when driven from the pinion on the shaft *J* to the gear *J*-5 of the lead screw.

The Carriage and Bed

Fig. 9 is a plan view of the carriage showing a portion of the apron in section, Fig. 10 a front elevation of the apron, and an end sectional view of the apron, bed and carriage taken through the center of the half nut. Fig. 11 is a sectional side view of the apron, bed and carriage taken through the center of the cross-feed screws. The central bearing or shear is a solid plate extending to within ¾ inch of the spindle center and the carriage rests on and is guided by a large single V formed upon the plate. A smaller V is provided for the head and tailstock and an extra track planed at an angle forms a bearing for the bridge of the carriage close to the center of the downward line of strain. The carriage bridge has a taper gib resting upon this and adjusting screws to compensate for wear. This does away with the carriage bridge bearing directly on the tailstock V's on the front side as a support and avoids the wear which tends to bring the tailstock center below its correct aline-

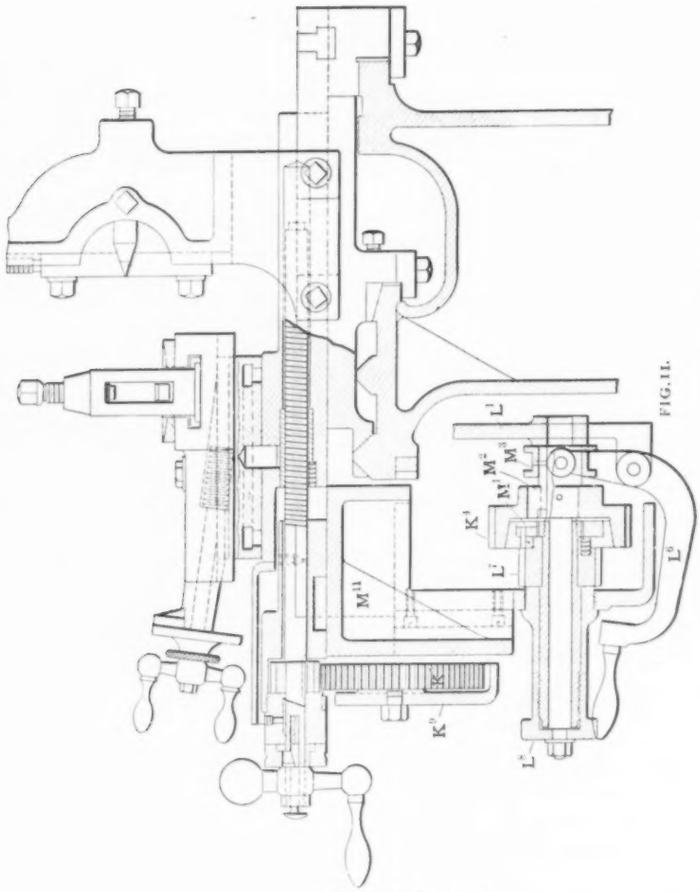


FIG. 11.

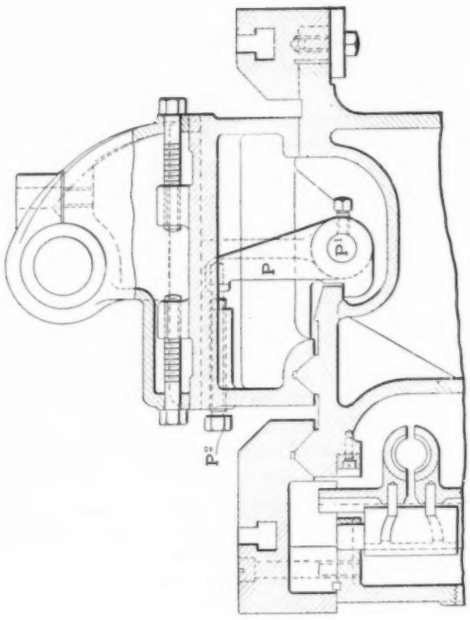
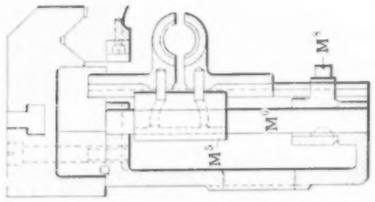


FIG. 14

THE BED AND CARRIAGE



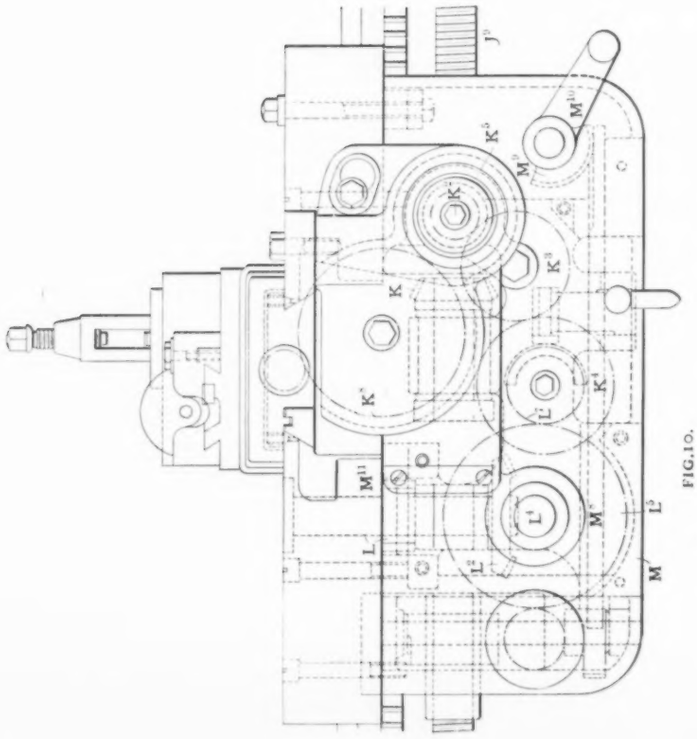


FIG. 10.

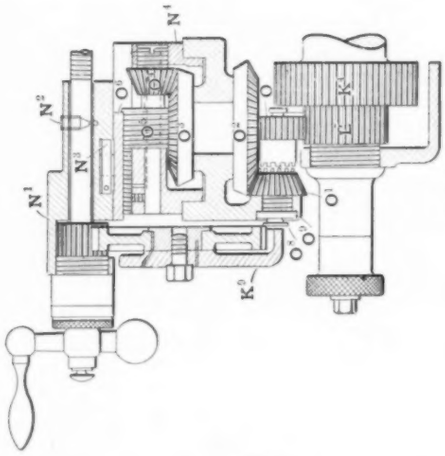


FIG. 13

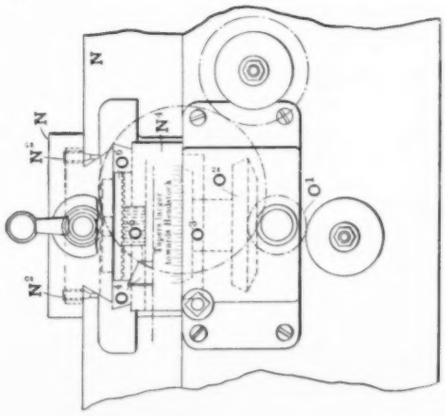


FIG. 12

DETAILS OF THE TAPER ATTACHMENT

ment with the head. The back part of the shear is planed flat to receive the tail-stock and the back wings of the carriage both of which slide upon but a single V. The lead screw is splined to receive the bevel pinion *K*, Fig. 11, and this meshes with the bevel gear *K'* secured to the pinion stem *K*-2 which transmits motion through the intermediate *K*-3 to the longitudinal friction gear *K*-4. The pinion stem extends out through the bearing in the apron and carries the nurl *K*-5 and the friction *K*-6. The friction *K*-6 mates the friction gear *K*-7 and transmits motion to the cross-feed screw through the intermediate gear *K*-8 which meshes with the cross-feed screw pinion. In Fig. 13 it will be seen that the top slide of the compound rest is fed by an inclined screw, and this is done for the purpose of giving increase traverse to this part without causing extreme length and also for the purpose of elevating the compound rest handle to prevent any interference with the cross-feed handle. A rack is secured to the swivel of the compound rest and which is keyed to the shaft *L*-4. The shaft *L*-4 is keyed to the hub of the spur gear *L*-5, and the hub of this gear takes its bearing in the apron. The pinion of the apron ball-crank stem meshes with the gear *L*-5, and these gears are so proportioned that one revolution of the ball crank makes the carriage travel exactly 1 inch. The spur gear *L*-5 also meshes with the pinion *L*-7 from which it receives its power for feeding.

Chasing Threads With Rack Feed

In Fig. 11 is a sectional view of the longitudinal friction, and the positive chasing device for chasing threads through the rack feed is operated by the lever *L*-6. It will be seen that the pinion *L*-7 which transmits motion to the rack pinion has a friction mounted upon it which engages with the friction of the gear *K*-4. This friction may be locked and released by the regular longitudinal-feed nurl *L*-8. Mounted within the friction gear *L*-7 is a hardened-steel index ring *M*-1. The gear *K*-4 is provided with a key seat to receive the sliding tool-steel key *M*-2, and this key is operated by a sliding collar *M*-3 and is controlled by a shoe in the crank portion of the lever *L*-6. The divisions in this index ring *M*-1 are made to correspond to the pitch of the lead screw of the lathe, and in the case of this particular machine, the lead screw has four threads per inch, and it is obvious that the half nuts may be engaged at every quarter inch. Therefore the divisions of the index ring *M*-1 are such that a quarter-inch movement of the carriage will allow the key *M*-2 to enter the slot of the index ring and lock the feed positively. This forms a positive drive through the rack pinion, and not through the friction, and while very accurate chasing cannot be accomplished by this method, all roughing can be done and threads may be roughed to within a few thousandths of the size without wearing the screw, and then the half nuts engaged for giving an accurate finish.

The half nuts are mounted at the left of the apron so that the carriage may be moved to its farthest limit at the tail-stock end of the bed without interfering with the lead-screw bearing at this point. Fig. 12 shows a sectional view of the half nuts which are opened and closed by the cam *M*-5. This cam is operated by the rack *M*-8 from the crank *M*-10. Since the regular rack feeds are in the same ratio as the screw feeds and in the same direction, it is obvious that even though the rack and screw feeds may be engaged at the same time, no serious results will occur. The apron has a dummy-plate casting *M*-11 secured to it by screws and this plate is always supplied to the lathe when furnished without the taper attachment and fills out the space which is occupied by the taper attachment when the machine is furnished with one.

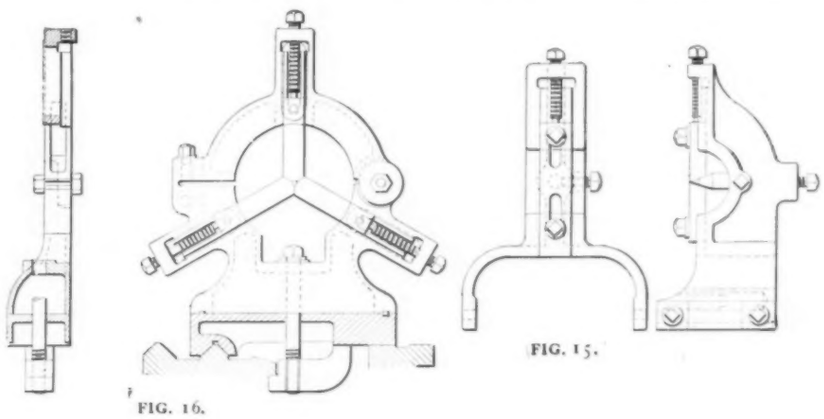


FIG. 15.

FIG. 16.

STEADY AND FOLLOWER RESTS

this rack meshes with the inclined screw shown.

The cross-feed screw is provided with a spring-seated plunger in the center of the ball crank which operates a friction for locking and releasing the graduated collar of the cross-feed screw. The rack is secured to the bed with the teeth facing outward instead of down, as is the ordinary practice. This is to bring the rack pinion *L* in a vertical position. This pinion has a solid stem on either side and the top fits directly into the carriage. This top is provided with an adjustable dial, which is let into the counterbore in the top of the carriage and is graduated to read to 64ths of an inch. The rack is ½-inch circular pitch and is accurately spaced so that a correct longitudinal reading may be had from this dial. The dial has a friction-locking device similar to that of the cross-feed screw, and may always be set to zero. The lower end of the rack pinion *L* takes its bearing in the back plate *L'* of the apron *M*, Fig. 11, and has the bevel gear *L*-2 keyed to it. The bevel gear *L*-2 meshes with the bevel pinion *L*-3,

The Taper Attachment

Fig. 12 shows a front view of the taper attachment and Fig. 13 shows a sectional view. The carriage *N* has a slide *N*-1, which confines the bearings of the cross-feed screw and is arranged to move across the carriage, the traverse being accomplished by the sliding shoe *N*-3 mounted on the slide *O*-6 of the swivel block *N*-4 of the taper attachment. When the taper attachment is not in use, the dowel screws *N*-2 lock the slide *N*-1 to the carriage *N*. The sliding spur gear *O* meshes with the friction gear *L*-7 of the apron and has clutch teeth to engage the bevel pinion *O*-1. This train drives the bevel pinion *O*-4, which is keyed to the screw or worm *O*-5. This engages the threads of the sliding block *O*-6, which has a pin formed upon it to receive the sliding block *N*-3. Block *O*-6 is dovetailed into the swivel *N*-4, which may be set at any position and locked. This swivel is stamped in degrees from zero to 90 and it is also stamped "Tapers larger toward Headstock." Directly opposite this stamping on the other side of the circle it is stamped "Tapers smaller toward Headstock" and the graduations are also opposite.

The engagement of the clutch of the spur gear *O* with that of the bevel gear *O*-1 is accomplished by a pull-pin *O*-8 and this pull-pin cannot be pulled out to engage this clutch unless the cover *K*-9 is removed. It is evident that the cross feed is never needed while the taper attachment is being used and the removing of this cover thereby throws the automatic feed of the screw out of engagement. The feed of the sliding block is much slower than the longitudinal feed of the carriage, and although this feed could be arranged in almost any ratio, it is deemed best to make it one-sixth that of the carriage. The maximum traverse of the block *O*-6 within the swivel *O*-4 is 4 inches, and its feed is one-sixth that of the longitudinal traverse of the carriage; so that when the swivel *N*-4 is set as indicated in Fig. 13, the block *N*-1 confining the cross-feed screw will move 4 inches while the carriage is moving 24 inches. Therefore, the

length of taper which can be turned at one setting is 24 inches and the amount of taper will be from zero to 8 in 24 or 4 inches taper per foot. A table is furnished with each attachment giving the tapers in inches per foot from 1/16 to 4 inches and the corresponding included angle. It also gives the setting angle of the taper attachment swivel *N*-4 in degrees. The fact is that the power is transmitted to the taper attachment and the longitudinal feed through about the same number of gears, so that the back lash of these parts is less than with the ordinary device and in fact it is found in actual practice to be much more direct than the usual form of taper attachment. This form of taper attachment is subject to a great number of variations and it will be seen that if it is necessary to turn a taper of but 2 inches to the foot, the gearing could be so proportioned as to give this as a maximum taper. In this case the feed of the taper attachment block would be one-twelfth of that of the carriage feed and the lathe would be capable of turning a taper 48 instead of 24 inches long and so on. The taper attachment is secured to the apron through the same holes as are drilled for securing the plate *M*-11 and the device can be attached at any time after the machine is installed.

THE TAILSTOCK, FOLLOW AND REST

Fig. 14 shows the tailstock and the method of clamping it to the bed. The clamp *P* is mounted on the rod *P*-1 which takes its bearing within the lugs of the base of the tailstock. A tool-steel screw *P*-2 bears against the tool-steel block at the top of the clamp and these parts are hardened to obviate excessive wear. The tool-post wrench takes the adjusting screw *P*-2 and a very slight pressure against this screw will cause the clamp to bear very tightly under the shear of the lathe bed. The top of the tailstock can be adjusted independently of the clamping of the base to the bed, as is the case with heavier lathes to insure against slipping back when setting for tapers for heavy jobs.

The follow rest shown in Fig. 15 straddles the bridge of the carriage and is provided with three jaws. Although this style of follow rest has been in use before, Mr. Schellenbach believes himself to be the first to use it, having designed such a rest over fifteen years ago. The steadyrest is shown clearly in Fig. 16 and it is mounted on an auxiliary base which has a key in it to receive the main portion of the rest. Where a lathe is designed with a single V, it is impossible to apply the steady rest to the machine to face in but one direction but in mounting it as shown, it is evident that the steady rest will face in either direction and can be clamped into position by the long cap screw which is tapped into the clamp and which also takes the tool-post wrench.

The countershaft is provided with two friction pulleys and one 18x4 driving pulley and where it is not thought necessary to drive in both directions, the machine may be driven at two forward speeds, thus giving 32 changes of speed to the headstock spindle instead of 16 as is ordinarily given with one speed countershaft.

This machine is manufactured at the present time in 14-, 16- and 18-inch sizes and is supplied with three-step cone type of head which has some novel features. It is also made with plain set of change gears instead of the quick change as shown. This was designed by W. L. Shellenbach, and is manufactured by The John B. Morris Foundry Company, of Cincinnati, Ohio.

A Magnet Frame Drilling Machine

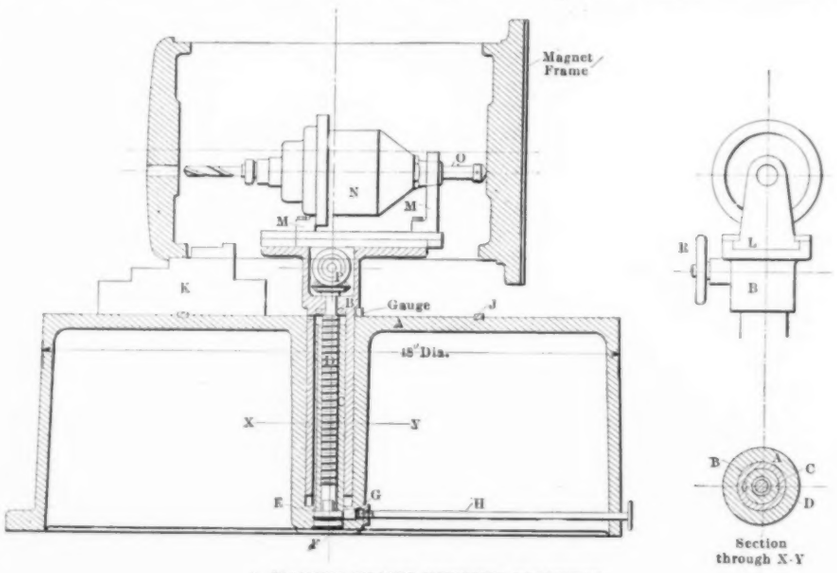
BY P. FENAUX

This machine was designed to render easy the drilling of radiating holes in magnet frames or housing for electrical machines. In these machines the center lines of the holes for holding pole pieces, interpoles and also of the holes for leads, ought to pass by the center of the magnet frame. To drill such holes on the drill press necessitates a big pile of wood shoes, a set of clamps and bolts, and yet the work is not often well done. It is necessary to move the casting for each hole and get it in position with the help of a plumb-bob and the twisting of the machinist's head to see that the line corresponds with the markings on the frame.

The machine is composed of a base *A*, high enough to be rigid under the heaviest frame which can be put on it and strengthened internally with ribs. A pocket is cast in the center and bored out to fit the support *B*. The top of *A* is finished and a groove is cut corresponding in diameter to one of the grooves in the table of a boring mill in the shop. In that groove is fitted a steel ring *J* used to center the blocks *K* on which the frames rest. There are a number of sets of three each of these blocks, with steps cut to fit the standard bores of the magnet frames.

The support *B* is planed on top so as to form a slide for a plate *L* on which is fixed by means of supports *M* a portable electric drill. There are two or three different sizes of drills which are mounted so that they may be changed in an instant to suit the different diameters of frames by sliding out one plate and replacing it by another. The feed is given by the feed screw of the drill, a longer movement is given by putting a piece of tubing between the screw and the frame.

Inside of *B* is fitted a sleeve *C* pressed on a hardened steel pivot *E* and bearing on a hardened steel washer *F*. This sleeve *C* is keyseated to the inside of *B* and forms a mit for a screw *D* driven through miter gears *P* by the hand wheel *R*. Thus, by turning *R*, the support *B* rises, the hight is given for each type of standard housing by a gage to be placed as shown in the illustration. The workman has a blueprint table giving him the size of gage to be used for such and such size of machine. When the right hight is obtained, everything is fixed in position by a brass shoe *G* pushed against *E* through a rod *H* coming outside of the base.



A MAGNET FRAME DRILLING MACHINE

Though this machine does not do away with the marking of lines dividing the circumference (for after trying an index we found out that in starting to work the drill had a tendency to move sidewise, not very much but enough to make a difference of 1/16 inch between 6 holes on a circle of 24 inches) it saves a great deal of time and bother.

When the frame becomes larger than the machine, it may still be used with the floor plate, by using a longer plate *L*; the length of bearing between *B* and the base allows such an extension.

Machining Multiple-throw Crankshafts

Economical Production in the Miller, Lathe and Grinder of Multiple-throw Crankshafts for Automobile Engines and Agricultural Machinery

BY J. C. SPENCE*

The machining of automobile, agricultural machine and other crank-shafts with more than one throw or crank-pin presents an interesting problem. Since the introduction of drop-forged cranks, the art of finishing them has made wonderful progress. The machining of the crank-pins is, of course, the difficult part of the problem. There are at present several methods of doing this work, these methods generally requiring special machines to make the pins. An exception is the method developed by the Norton Grinding Company, Worcester, Mass., within the last two years.

In this article I will attempt to make this method clear in detail, hoping that the description will call forth suggestions that will be of benefit to the makers of automobile engines.

Preliminary Operations

Fig. 1 illustrates a typical four-throw automobile shaft of the so-called "five-bearing" type.

The forging comes from the drop-forger straightened and centered. The first operation is called "turn for cut-off," which means that both ends are turned for a short distance before the forging goes to the cut-off machine. After being cut off to the required length, the shaft is re-centered in a Hendey-Norton centering machine, which is inspected every day and kept accurate within 0.002 inch. This machine grips the shaft by the turned portion, which insures that the new centers will preserve the original line of center made by the drop-forger, thus throwing the responsibility of the pins "cleaning out" onto him.

Rough-grinding the Bearings

The shaft is then taken to a 14x72-inch Norton plain grinder, where the four bearings *E F G H* are rough-ground to 0.035 or 0.040 inch oversize. Bearings *E F G* are ground by bringing forward a wheel with a face 2⅛ inches wide and using no lateral motion of the work. *H* is ground by bringing the wheel forward twice.

Milling Webs and Rough-turning Fillets, etc.

In the next operation, the right-hand end is rough-turned to 1.535 or 1.540 inches as far as the flange, and the left-hand end is rough-turned to 1.785 or 1.790 inches as far as the first "cheek." This is called "first turn."

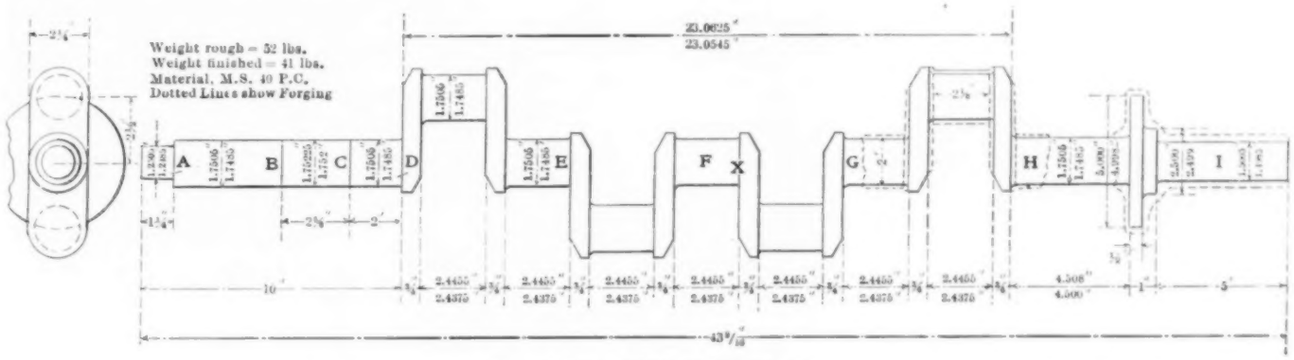


FIG. 1. A FOUR-THROW CRANK-SHAFT

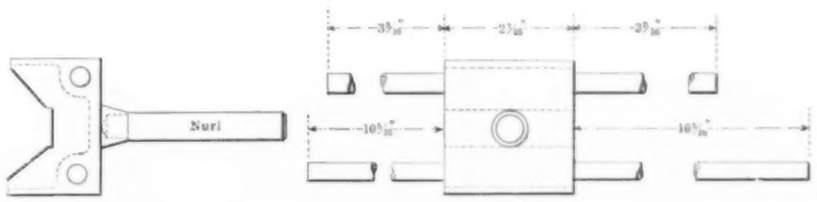


FIG. 3. LENGTH GAGE FOR LOCATING BEARING FILLETS

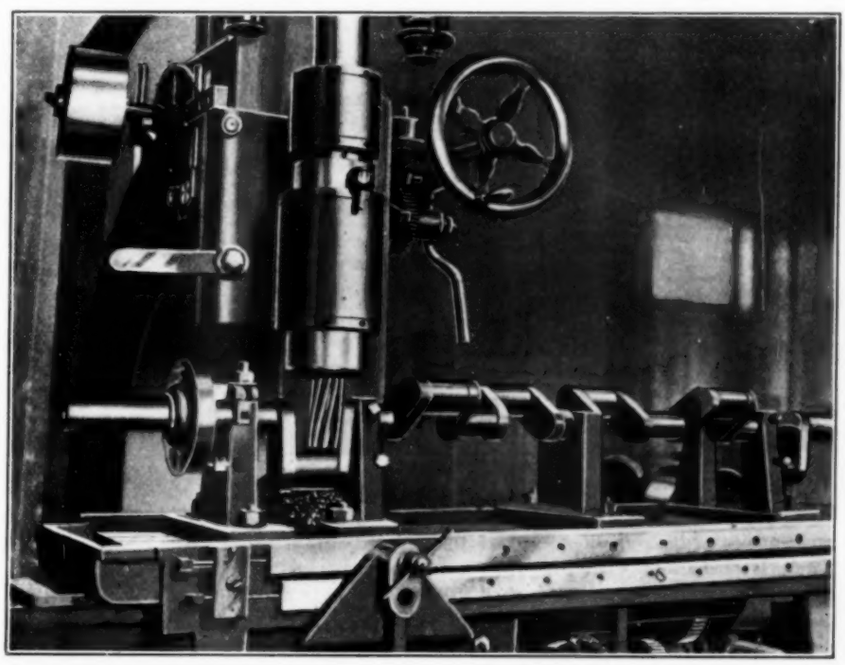


FIG. 2. MILLING CRANK-SHAFT WEBS

*Superintendent, the Norton Grinding Company.

Then the shaft is milled on the cheeks or webs. Fig. 2 shows a No. 5 Becker-Brainard vertical mill equipped for this operation. The V-blocks are designed to take any automobile shaft. The spacing bars (fastened to the front of the table) are made for each shaft and are adjustable to allow for sharpening the milling cutter.

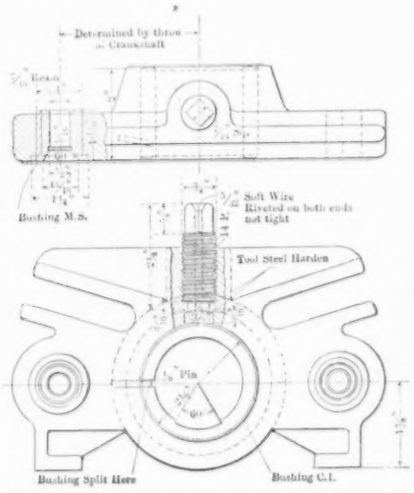


FIG. 4. CENTER BLOCKS FOR CRANK-SHAFTS

After milling, the bearing fillets on *D E F G H* are rough-ground. In this rough-turning, the fillet shoulders are accurately spaced by means of the gage shown in Fig. 3. All distances are taken from the center-bearing fillet nearest the flange. It is marked *X* in Fig. 1.

Next the flange is rough-turned all over, and the shaft is ready to have the ends fitted to the center blocks, shown in Fig. 4. This operation is done in the plate ring used as shown in Fig. 5.

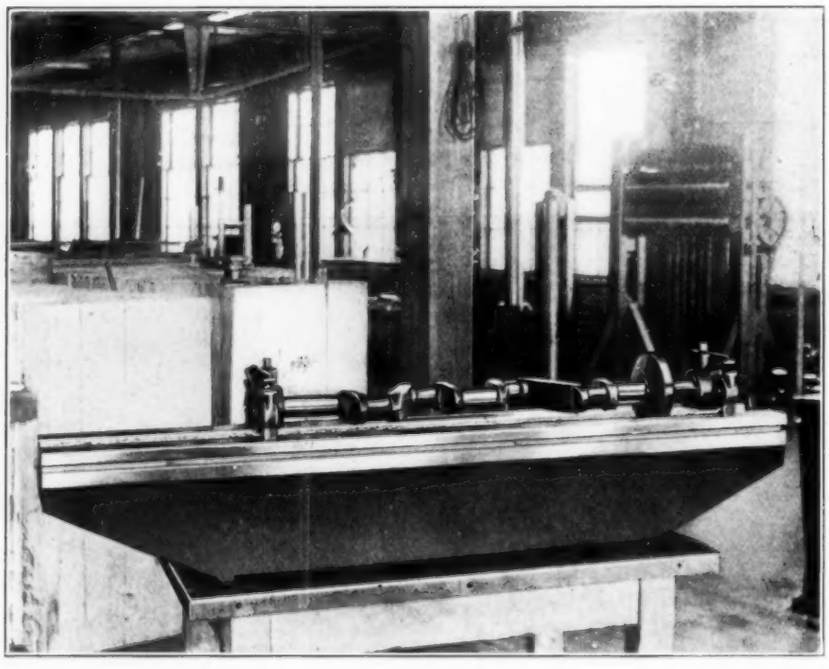


FIG. 5. USE OF THE SURFACE PLATE

The blocks are then put on, a surface grinder by bringing forward a wheel 2¼ inches wide. These end fits are made 1.514 to 1.515 inches on the right-hand end and 1.764 to 1.765 inches on the left-hand end.

Rough-grinding the Crank-pins

The crank is now ready to have the pins rough-ground. Fig. 6 shows a 14x72 Norton grinder set up for grinding crank-pins. The rough-grinding is done by simply bringing forward a wheel of the proper width and using no table traverse whatever. As will be seen in Fig. 1, the rough forging is ¼ inch larger in diameter than the finished pin. The pin in this particular shaft is rough-ground to 1.785 or 1.790 inches. I have seen this operation performed on a single pin, time and again, in two minutes, and occasionally in as short a time as 40 seconds. This means wheel-time only. Fig. 6 illustrates clearly the simplicity of the operation.

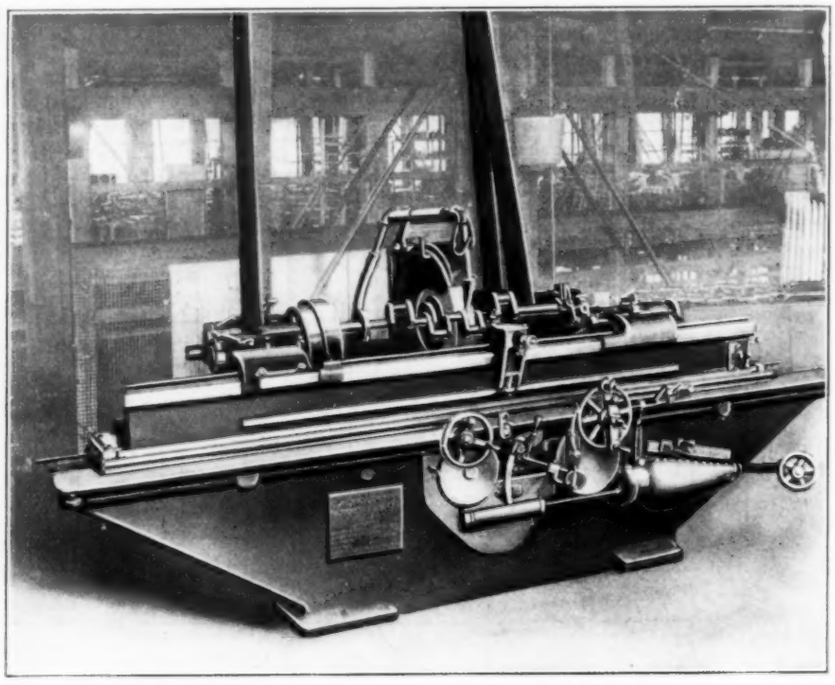


FIG. 6. NORTON GRINDER SET UP FOR CRANK-SHAFT WORK

Filleting Operation

After all four pins are rough-ground, the shaft is put into an ordinary lathe to have the pin fillets roughed out. The stock is removed by means of the common right-hand and left-hand round-nose tool of the proper radius. The pin is held steady by means of the special steady rest shown in Fig. 7. The fillet shoulders are accurately placed by the use of the gage shown in Fig. 8, all distances being relative to point *X*, Fig. 1.

The shaft is now straightened, if necessary, and returned to the grinder to have the pins finish-ground. Again, the wheel used has a face wide enough to make the pin without table traverse.

To finish the pin fillets to proper radius the lathe is again resorted to and the pin held steady as in the fillet-roughing operation. This fillet-finishing operation can be done on the grinder, if desired; in fact this is necessary when the shaft is hardened. We have made shafts both ways, although, taking into consideration the extreme accuracy of radius and location of shoulders required by most engine builders, we prefer to use both grinder and lathe.

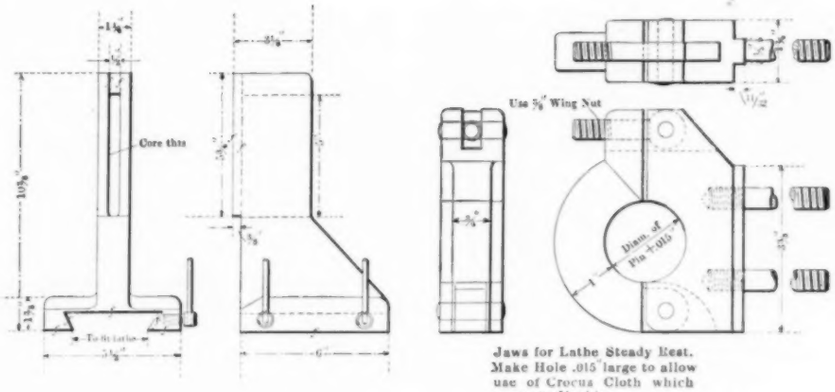


FIG. 7. LATHE STEADY REST

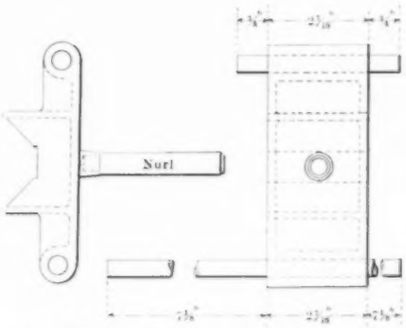


FIG. 8. Gage for Locating Crank Pin Fillets

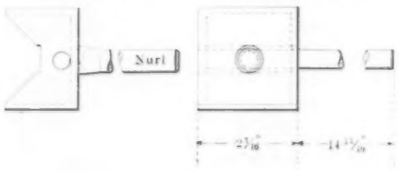


FIG. 9. FLANGE LOCATING GAGE

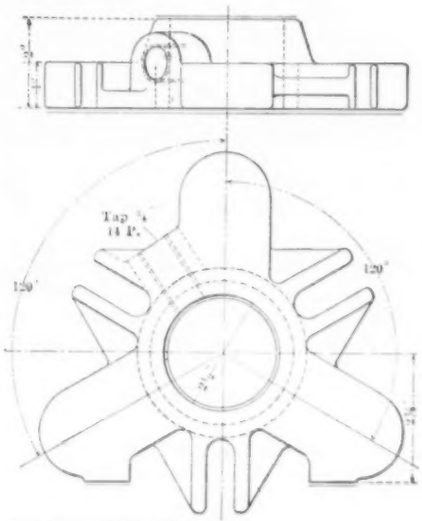


FIG. 11. STYLE OF CENTER BLOCKS

Finishing Operations

After finishing the pin fillets, the center blocks are removed and the shoulder *A*, Fig. 1, is turned down. This is left large up to this time to allow as good a grip for the center block as possible.

The parts *A B C D E F G H I* and both of the flange diameters are then ground to the drawing limits. The fillets on these last-named parts are then finished to correct radius and the flange is squared smooth and to correct dimensions, the location being determined by the gage, Fig. 9.

After the shaft is inspected for running true and squared to length it is complete.

Other Shafts

Fig. 10 shows a six-throw shaft similar in construction to the four-throw shaft of Fig. 1. This shaft is handled in exactly the same manner. Fig. 11 gives the style of center block used for the six-throw shaft. Fig. 12 illustrates a shaft of the "three-bearing" type. This shaft is of 3½ per cent. nickel steel. The lathe and milling times in Table 1 show the effects of this hard material, but the grinding time is not very much affected. Note the quantity of material removed in order to produce this shaft.

Fig. 13 shows a shaft designed to avoid all machine work on the webs. Fig. 14 is an example of a very difficult shaft to machine. The cheeks are thin, allowing much spring unless the operator is extremely careful.

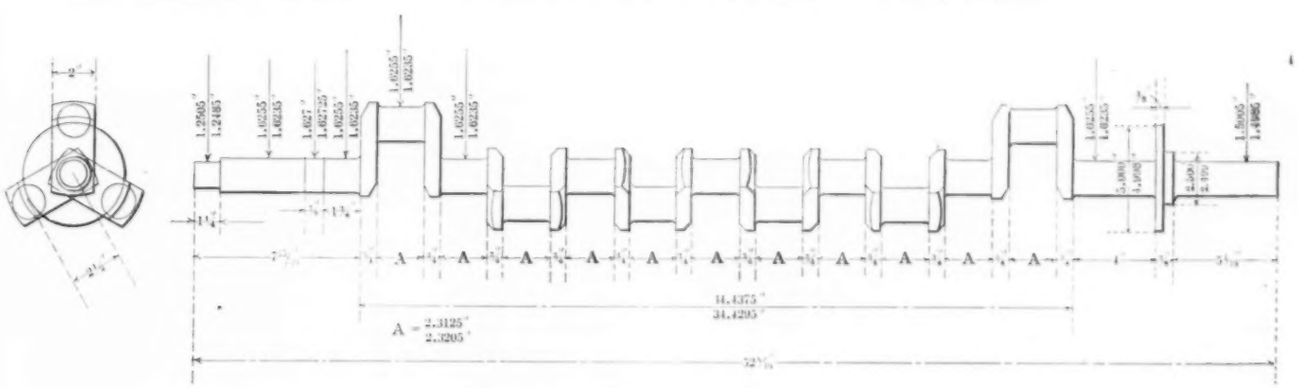


FIG. 10. A SIX-THROW CRANK-SHAFT

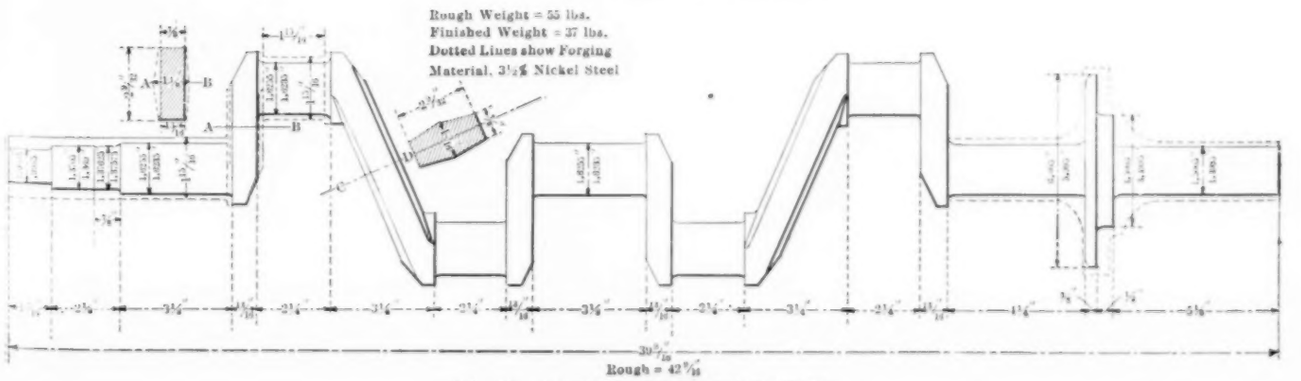


FIG. 12. A NICKEL STEEL CRANK-SHAFT

Shafts for Agricultural Machinery

Figs. 15 and 16 are given to bring out the possibilities of the grinder. These shafts are both used in agricultural machinery. They do not need to have a fine finish. This allows the operator to push the work with the one idea of time in his mind. The only operations not done on the grinder are the cutting off and centering and the rough-turning of the ends. The other bearings and the pins are made complete in the grinder. The ends are finish-ground in addition.

Schedule of Time Required to Machine Shafts

In Table 1 of operation times, here included, there is a column marked "average time" and one marked "best observed time." The average time is taken from the time cards after the completion of a large number of shafts; the best observed time was picked up here and there, whenever conditions were favorable.

A separate schedule, Table 2, showing the *average* time taken to produce these shafts is given. Bear in mind that these forgings are almost 7 feet long and only 1½ inches in diameter. To attempt this job in the lathe would make the reader appreciate the time given in the table.

	Fig. 15.	Fig. 16.
Cut off and center	10	10
Grind bearings (except ends)	15	22
Turn ends	15	15
Grind ends	8	8
Grind pins	30	45
Total time	78	100

All time given in minutes and includes handling.

TABLE 2. AVERAGE TIME REQUIRED TO MACHINE SHAFTS SHOWN IN FIGS. 15 AND 16.

The success of the system which has been described in this article and the various features of which are illustrated by the half-tone and line engravings depends, like all others, on common sense. An operator who violates natural laws will produce a shaft in which the crank-pins are out of line with the bearings and in which the pin fillets are not concentric with the pins themselves. But if he does not spring the shaft by too much pressure from the footstock center and learns the true duty of the backrest on his grinder, he cannot fail to produce correct shafts at small cost.

It is reported that a student of the Electro-Technical Institute of St. Petersburg named Freudinberg has invented an apparatus for exploding mines by wireless telegraphy, according to the *Engineer*. Numerous experiments already made are said to have proved remarkably successful.

	Fig. 1.		Fig. 10.	Fig. 12.		Fig. 13.	
	Average Time.	Best Observed Time.	Average Time.	Average Time.	Best Observed Time.	Average Time.	Best Observed Time.
Turn for cut-off	7	4	12	10	5	6	4
Cut-off and center	8	6	8	8	6	6	5
Rough-grind bearings	36	18	50	28	14	17	15
First-turn ends	17	10	18	17	12	12	8
Mill cheeks	47	30	90	31	22	..	..
Rough bearing fillets	65	35	70	60	30	55	30
Rough-turn flange	36	20	40	48	30	..	..
Grind for center blocks	5	3	5	5	3	5	3
Rough-grind pins	31	12	42	36	12	24	10
Rough pin fillets	65	27	70	79	48	72	45
Straighten	20	1	20	20	1	20	1
Finish-grind pins	46	10	50	46	10	37	10
Finish pin fillets	40	15	40	40	15	30	15
Second-turn ends	7	5	12	10	7	12	8
Finish-grind bearings	51	36	70	46	30	42	30
Finish bearing fillets	36	15	40	30	12	30	15
Finish-turn flange	36	20	40	41	25	..	..
Square ends to length	7	4	12	8	4	7	4
Total time	560	271	689	563	286	375	203

All time given in minutes and includes handling.

TABLE. 1. TIME REQUIRED FOR VARIOUS OPERATIONS ON CRANK-SHAFTS SHOWN IN FIGS. 1, 10, 12 AND 13.

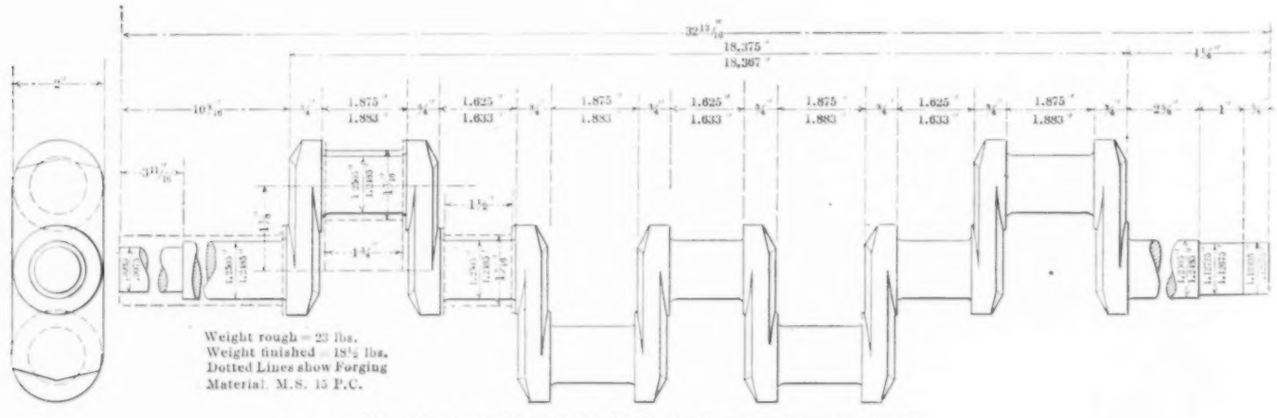


FIG. 13. A CRANK-SHAFT REQUIRING NO FINISH ON WEBS

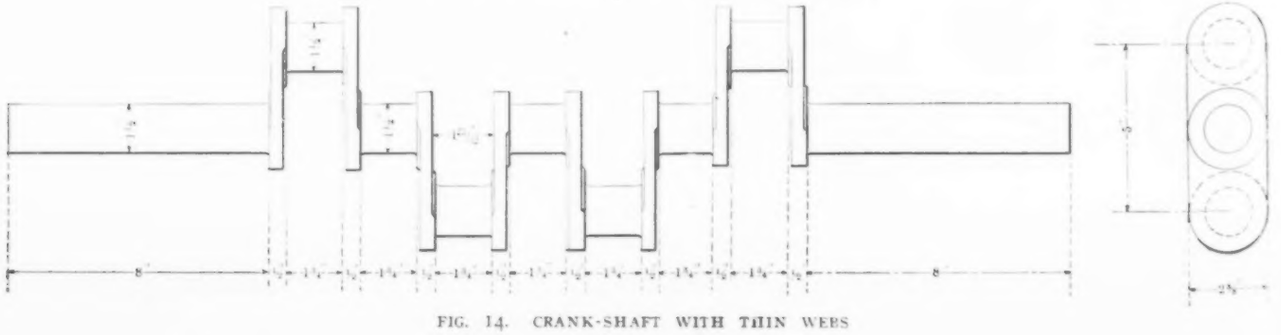


FIG. 14. CRANK-SHAFT WITH THIN WEBS

Some Vicissitudes of the Job Shop

By J. G. Dornbirer

A skewer is a pointed, round stick used by butchers and packers to make bad looking slabs of meat look eatable. In the early eighties there were three concerns in the United States and one in Canada engaged in making nothing but these little round-pointed sticks. They are made from 3/16 to 7/16 of an inch in diameter and from 6 to 16 inches long. All but one of these concerns pointed their product by taking one at a time and sticking it into a device similar to a power-rotated lead-pencil sharpener. The maximum output was about four or five thousand per day for each operator. The other concern had five machines operated by two men which combined could point 700,000 skewers per day. Needless to say there is but one concern now.

The concern owning these machines never had them patented, but kept them carefully guarded. They were in a separate part of the factory and were operated by the owner's nephew and brother-in-law. The owner's father-in-law was the inventor. This pointing machine was invented about 12 years before there was a demand for skewers. In fact the present almost universal demand was created by this concern, so they would have had very little use or benefit from them before the patent would have expired.

Now the boss stood very close to the old inventor of the machine (the boss having served his apprenticeship under him). So we got an order to replace five of them which had been destroyed in a fire. We were furnished blueprints which the boss kept in the safe, and they were assembled in a separate room. The machine was remarkable in its simplicity. Two hundred and fifty dollars would build one and leave a fair profit.

One day a man came around who claimed to have a process whereby he cleaned drawings, tracings and blueprints at five cents per sheet. The boss took him into the office and gave him about 70 sheets to be renovated. The man looked them over carefully then shoved them aside claiming that they were too dirty, packed up and left. We learned afterward that he came in the hopes of getting onto the skewer-pointing machine. Shortly after this a smart-looking man came and applied for a job at very attractive wages. He claimed that he was the possessor of a great many human traits that made him almost indispensable about a job shop. Well! we needed a man and hired him. He soon learned that we had just completed an order of five pointers which would last a lifetime and he disappeared.

One day a man came in and talked with the boss for a while, then placed an order for 25 machines. The boss saw at once that they were skewer pointers of the "lead-pencil sharpener" type. The next day he came again and requested us to make improvements on them, told their purpose and offered to pay well for everything. But the boss kept well the secret of the skewer pointer.

The owner of the skewer factory was a good patron of our shop and piloted other manufacturers over when they were in need of our services. Like most owners of job shops, the boss was often in need of financial assistance and always got it from the skewer manufacturer. He was frequently invited to the skewer-maker's house for Sunday dinner served at about one p.m., with something to eat. The boss learned that it paid to be square along lines not required by civil law. In a few weeks the man who ordered the 25 small pointing machines came in and offered the boss $15,000 point blank for four machines. The boss requested till the following noon before making an answer; the money looked big, in fact the young boss did not think there was so much money in this world. He finally made up his mind to go and see the skewer manufacturer and lay the case before him. He offered to give the man one-half if he would consent to let him build the machines for the competitor.

The old man recognized what a great temptation this was for a young man, but endeavored to show the boss that the game was not worth the candle. Now he said, "let's go to your office." They did. After arriving he said, "open your books and see what we paid you in the last 18 months." It amounted to $3500. "How much have the different concerns paid you, to whom I have recommended you?" All told, about $8500. "Whenever you needed money I lent it to you, you were once in our employ and we paid you fair wages and treated you well and I believe I can be of considerable use to you in the future." This was enough. The boss decided then and there.

The other skewer manufacturer advised, upon hearing the boss' ultimatum, that the boss hadn't brains enough to play a triangle in a church choir.

Now in the course of about eight years the boss sold out and moved back to his native city and started into business there on a large scale. It needed more money, the skewer maker advised him to do his banking business at such and such a bank, as the banker was a friend. From this bank the boss never had any trouble in getting money when he needed it. Well! business was very slack in '95 and had been so for two years, when one morning in the mail was an order for 10 skewer-pointing machines from the boss' old friend the skewer maker at $500 apiece.

Now I know that a great many young men do not believe in the boss' policy, and characterize it as "the tail end of the procession." But don't forget in that position you won't be stepped on.

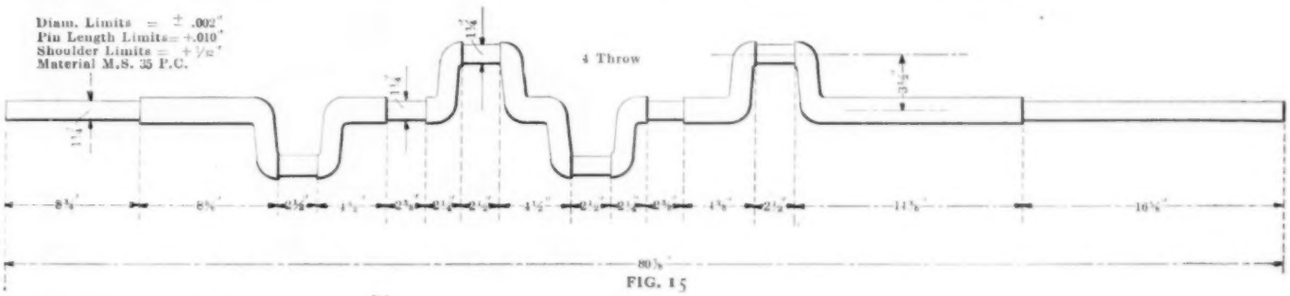


FIG. 15

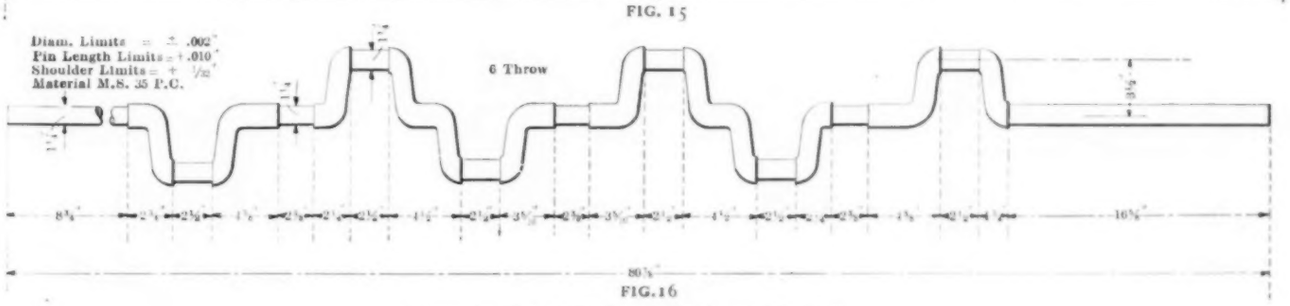


FIG. 16

CRANK-SHAFTS FOR AGRICULTURAL MACHINERY

A New Variable Speed Transmission Device

A Novel Application of the Floating Disk in Order to Secure Large Speed Ratios and a Reverse Motion with Simple Construction

SPECIAL CORRESPONDENCE

Most mechanics who have studied the automobile problem at all have devoted more or less thought to the transmission of the power from the motor to the wheels, and while friction clutches have given way to the sliding gears, in many cases, we all realize their shortcomings, in spite of the extent to which they are used.

When it comes to transmitting heavier powers, such as driving a passenger car on a railroad, the gears are not altogether satisfactory, and some resort to the use of a dynamo and motor as a transmitting device. Gears, too, have the disadvantage of changing speed by jumps or steps, instead of a gradual increase or decrease, and anything which will give the desired changes positively and without too much complication, not only appeals to users of motor-driven vehicles, but to machine-tool builders and users as well.

The latest device along this line is the Dieterich universal drive, applied to the axle of an automobile, but equally applicable to other drives. The principle is not new, but the way in which it is worked out is believed to be different and to obtain better results than has been accomplished heretofore.

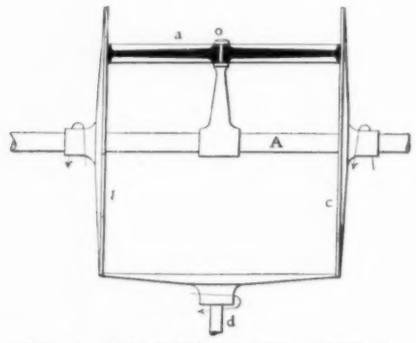


FIG. 1. THE FLOATING DISK PRINCIPLE

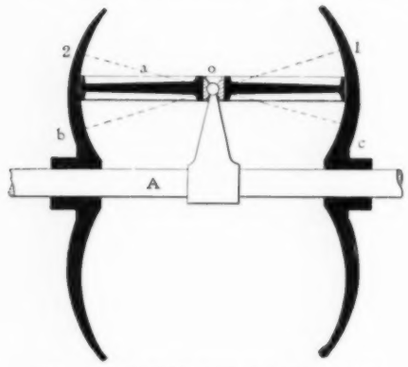


FIG. 2. TILTING THE FLOATING DISK

Fig. 1 shows a driving device of three disks or bevel gears *b*, *c* and *d*, *d* being the driver from the motor or other source of power. This will drive disks *b* and *c* in opposite directions. Shaft *A* is loose in the bearings of the side disks and the wheel *a*, turning on *o* of the support on *A*, simply revolves on the support and imparts no motion to the shaft as long as the two disks *b* and *c* turn at a uniform rate in opposite directions. If one disk is slowed down, the wheel *a* travels with the faster disk, and turns the shaft *A* just in proportion as the speeds of the two disks vary.

But in the Dieterich drive both disks are driven positively by gears or friction, as desired, each being positive in its way, the gear until it breaks a tooth, and the friction until it slips and abrades the surface of one disk or the other. The change of speed is accomplished by making the driving disks concave and swinging the floating disk *a* on its center *o*, as shown in Fig. 2. With the disk *a* horizontal the shaft *A* receives no motion, but swinging to either position shown, the shaft *A* turns in the direction of the disk on which *a* runs nearest the circumference. If it tips up to 1 it will run with that disk, and if to 2, it runs with the disk 2. This, then, given both forward and reverse motions to *A*, or allows it to stand perfectly still if *a* is kept horizontal.

This looks a little familiar, as in a speed-changing countershaft; but we find that the usual application is where the disk *b*, for example, is the driver and *c* is driven through the disk *a* at speeds varying with the angle of *a*. But this is a very different case, as will be seen by following the application of this principle in the driving axle in Fig. 3. Here the motor drives the gear *A* through the shaft from the motor. To reduce the length of the device the convex disks are not parallel, but angular, and the outer disks *D* are driven through the bevels *B* and *C* to get the right surface speed of both disks. All gears and floating disks run on Hess-Bright ball bearings, and the floating disks are controlled by the linkage system shown, a movement of the speed lever or pedal moving the floating disk into any position for forward or reverse or for stopping the car.

In automobile work it is necessary to have an independent drive for each wheel, on account of turning corners and to do

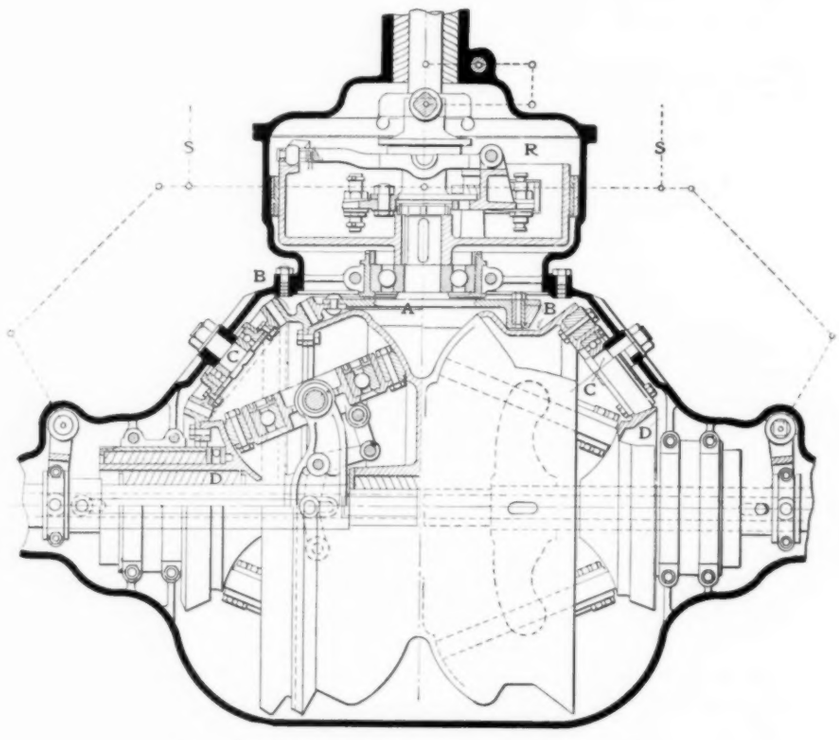


FIG. 3. UNIVERSAL DRIVING AXLE FOR AUTOMOBILES

away with the differential gears, which are troublesome in many ways, there is a drive for each half of the axle, as shown in Fig. 3. The linkage system is connected to the speed pedal by the center rod and to the steering mechanism by the rods *S S*, so arranged that the turning of the steering wheel drives the wheels at the proper speed for turning the corner and, unlike the differential gear, each wheel is driven positively whether on slippery pavements or in soft ground. There is also a simple device at *R* which takes care of different roads and grades when desired by acting through the same links to slow down or accelerate, as the case may be, and so utilize the full power of the motor or such portion of the power as desired at all times when nothing is in the way. The device is very simple and is intended to be used principally on motor trucks, with a constant-speed motor and the device set for, say, 10 miles an hour speed on the level. Then, on coming to a heavy grade the speed would come down to perhaps three miles an hour, but would return to 10 miles when the level was again reached, and no matter how much it slowed down, it would always climb the hill at some speed, even if only a fraction of a mile an hour, unless the wheels slipped.

For use on machine tools (and there is large field for a successful device of this type in this field) the mechanism is simple and can be reduced to that shown in Fig. 4, as there is no need of a divided driving shaft, as with the automobile. A mechanism of this kind in the head of a lathe or under a boring-mill table will give the whole range of speeds direct from a constant-speed motor and give them gradually instead of by steps, including a reverse motion, assuming, of course, that it works out as it promises.

It may be said that the whole device depends on the friction of the floating disk and the driving disks on the side, but unless these surfaces slip they are positive as gears except, perhaps, for a slight creeping of the surfaces. This means that the success or failure depends on the friction surface, and Mr. Dieterich has chosen compressed cork as the material for the bearing surface of the floating disks. Tests at several institutions show that the dynamic co-efficient of friction is 0.35 for cork on cast iron, as against 0.15 for steel on bronze, while for static friction this rises to 0.89 for polished cork against polished cast iron running in oil under a contact pressure of about 50 pounds. The elasticity of cork gives a surface contact instead of a line contact, as with a harder substance, and the fact that it holds well on cast iron and is not affected by oil is in its favor. Then, too, it will be seen that the peripheral speed of the floating disk is constant, regardless of the speed of the driven shaft, so that the driving power is not impaired by slowing down the surface speed, as is so often the case in friction devices.

Some interesting tests are now being made to show the efficiency of this gear and will help to show what merit it possesses. The advance reports are encouraging and full details will be available after they are completed.

The application of the device will be watched with interest by all who have to do with power transmission, and further details can be had of L. M. Dieterich, 2507 East 12th street, Kansas City, Mo.

F. H. C.

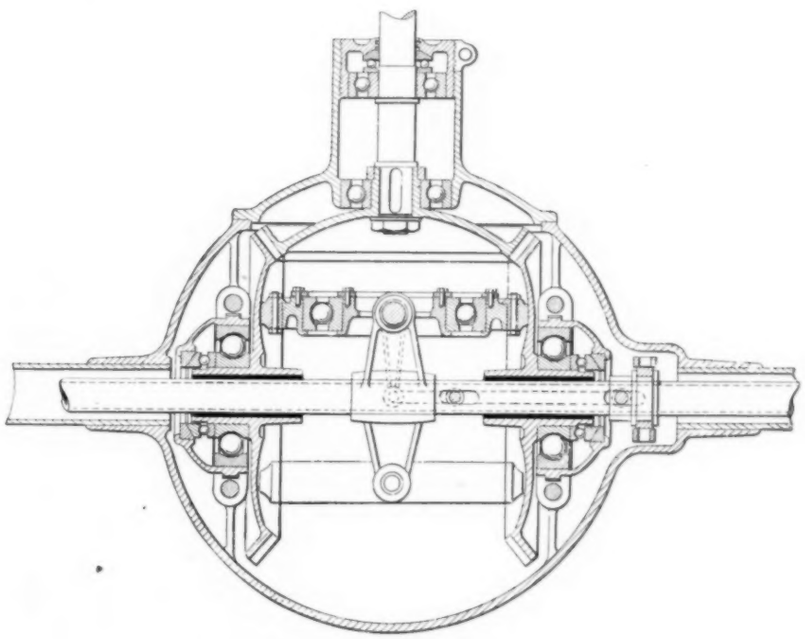
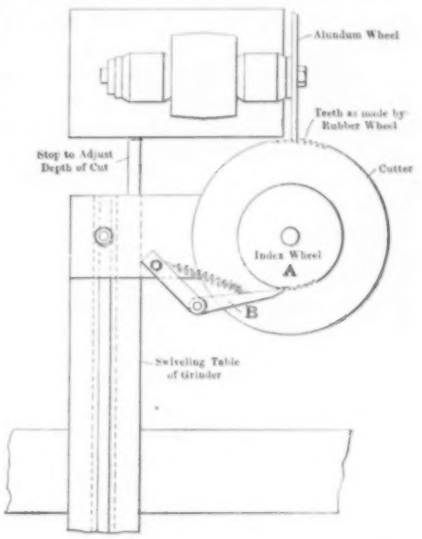


FIG. 4. A MODIFICATION OF THIS WOULD FIT MACHINE TOOLS

Recutting High-speed Steel Milling Cutters

By W. Alton

We use milling cutters of Novo steel, 10-inch diameter by ⅛-inch face, on some of our manufacturing operations, and as the work is very trying, sooner or later, some of the teeth are broken out and the cutter is spoiled. Our toolmaker then takes such a cutter and grinds off all the teeth, leaving a plain round disk. Then he mounts it on a Cincinnati universal grinder substantially, as shown in the sketch, with an index-wheel *A* having the same number of teeth that the cutter is to have. A spring pawl *B* engages the teeth of the index-wheel.



RIG FOR GRINDING TEETH IN HIGH-SPEED STEEL CUTTERS

He first notches the teeth, using a 1/16-inch thick rubber wheel, such as is used in cutting off small bars of high-speed steel. He then takes an alundum wheel, with the face dressed off to the right angle to make the teeth of the proper shape. After this is done the teeth are ground for clearance, using a regular wheel.

All this can be done in about six hours on a 10-inch wheel having 140 teeth, and it is then as good as new. With care there is no danger of drawing the temper, so this method ought to prove of value to anyone who uses these wheels.

The first 60,000-volt hydro-electric plant in Japan has been put into service. Power is obtained by impounding the Ugigawa river, narrow, but deep and swift, such as is often found in the mountains of Japan. The normal full-load capacity of the station is 18,000 kilowatts, furnished by six 3000-kilowatt alternators driven by water wheels, and supplying current at 6600 volts and 50 cycles.

Machine Tool Builders' Association

The National Association in Semi-annual Convention Discusses Cost Accounting, Relations with Dealers and Consumers and State of Trade

EDITORIAL CORRESPONDENCE

The Machine Tool Builders' Association was called to order by President Eberhardt at the Chalfonte Hotel, Atlantic City, Tuesday morning, May 19. He referred to the critical times through which the machine-tool industry is passing and the importance which these gave to the convention. He considered it remarkable that prices have been so well maintained and that in fact there should have been so little call for reductions by prospective customers—a condition in which there has been a marked change during the past ten years—previous periods of depression having always been accompanied with wholesale calls for lower prices. He considered that the worst is over and that normal conditions will reappear with the clearing of the political horizon. The finances were shown to be in satisfactory shape and applications from five new members are on file.

Uniform Cost Accounting

Following these remarks the reports of standing committees were called for, of which the first was that of the Committee on Uniform Cost Accounting. In the absence of the chairman of the committee, F. A. Geier, the report was presented by C. Wood Walter. Mr. Walter referred to the labors of the committee in the past and to the action of the last convention in authorizing the committee to employ an expert in formulating its conclusions. Pursuant to this authorization, the committee had engaged the Miller & Franklin Company, of Boston, Mass., who, after a thorough examination of the subject, through extended correspondence with the members of the Association, had drawn up a series of recommendations which had been put in pamphlet form for distribution at the meeting.

Mr. Walter considered that the profits of the machine-tool industry are not large enough for the risks and skill involved, especially as from the nature of business only a small percentage of the net earnings can be drawn out in dividends. Considerable investigation had convinced him that the profits of this business are low compared with other lines of manufacturing.

This condition is due partly to the fact that many in the business are satisfied with small profits, that others are satisfied to turn substantially all the profits back into the business, that others deceive themselves regarding the true cost, and to widespread ignorance of the cost of doing business.

The object of the committee has been to draw up a schedule of items to be included in calculating costs. The committee had not felt called upon to present a complete scientific system, nor had it attempted to devise a uniform system of bookkeeping for general adoption although it has presented an illustrative system, showing how its recommendations may be carried into effect. The inquiries of the committee have developed the fact that some of the members make no effort whatever to figure costs; others figure material and direct labor only; others estimate the overhead expenses, while others figure these expenses, but omit necessary items. He urged that, for the sake of uniformity, the recommendations of the committee be followed even by those who do not absolutely agree with their recommendations, the essential point being that all include the elements of cost pointed out in their schedule, and he expressed the hope that the report would be accepted in a broad and not a too critical spirit.

Mr. Franklin, of the Miller & Franklin Company, was called upon for an account of their conclusions and he began by stating that, as a result of their inquiries, his company had concluded that rather less than one-third of the members of the association use good systems. The feasibility of the methods explained in their report is shown by the fact that it is now in use in its entirety by two manufacturing companies. In one of these it has involved no increase of clerical labor, while in the other, where previously no cost system had been in use, it had involved the employment of one $12 per week clerk only. He pointed out that it is not a memorandum system, its essential feature being a series of checks by which the correctness of the figures is assured.

At the conclusion of Mr. Franklin's remarks, he answered some questions which were put to him by the members, and following this a resolution was passed recommending that the methods embodied in the report be adopted by the members and that the committee be continued.

Apprenticeship

Following this came the report of the Apprenticeship System Committee by its chairman, E. P. Bullard, Jr. Mr. Bullard stated that the work of his committee is practically complete and that the result of it has been a large amount of laborious correspondence with those who wished information about it. He asked that the committee be continued and be authorized to compile a summary of their work in pamphlet form for distribution, and a resolution was passed granting these requests. A handsome steel engraved diploma has been prepared and is now ready for distribution, several having, in fact, been executed.

Prices

Following these reports came a discussion on the best policy regarding prices during the present period of depression, the result being a surprisingly unanimous expression of individual opinion that prices should be maintained, and there was even a strong sentiment on the part of some in favor of an increase. It was pointed out that, while wages and the cost of material are substantially unchanged, the percentage of overhead charges has largely increased, the net result being a decided increase in cost. It was urged repeatedly that no lowering of prices that is possible would stimulate demand and that a small reduction would only lead buyers to still further defer purchases in anticipation of further reductions. Many members were satisfied that the present stagnation is largely due to precisely this attitude on the part of buyers, especially European buyers, who seem to have assumed, as a matter of course, that reduced activity was to be followed by reduced prices and they have put off buying in consequence. Some of the members had corresponded with their sales agents and asked their views, which were substantially unanimous to the effect that no good could come from reduced prices, while several gave the manufacturers to understand that they would expect a rebate on tools now in stock, should prices be reduced. While no formal action was taken, the members were substantially and strikingly unanimous in the belief that no good and much harm would follow reduced prices, and it was made clear that this belief is also substantially unanimous among dealers.

Uniform Contracts with Dealers

The session of Thursday morning was opened by the presentation of a number of reports by special committees, the first to be of general interest being that from the committee to meet the National Supply and Machinery Dealers' Association

committee when necessary, presented by its chairman, I. H. Johnson, Jr. The question of a uniform contract form between manufacturers and dealers has been before the association for some time, and a form reported by this committee has already been put in type by the association. It has not, however, been found entirely satisfactory, and the present report related to certain contemplated changes, intended especially to cover the relations between the parties in cases in which the dealer has goods on hand or on order at a time when changes in prices are made. The committee had not been able to agree, majority and minority reports being submitted, and as the matter was somewhat involved, it was eventually referred to the executive committee to be digested by them, and then referred to the members by mail for further consideration at the next meeting.

Foundry Matters

The next report was from the committee on foundry matters by its chairman, Mr. Norton, and related to the difficulties which exist between machine-tool builders and the custom foundries, from which they obtain their castings. Majority and minority reports were submitted showing that the committee had submitted a series of questions to the members, the replies to which showed, in the words of the majority report, that there is something the matter with the conduct of the foundry business, the machine-tool builders being handicapped by the traditional methods of doing busines; which obtain in the foundry. The minority report did not find matters so serious. It considered the jobbing-foundry business to be only moderately successful, and that many of such difficulties as do arise come from the expectation of the best product combined with the lowest price. The majority report contrasted the condition of castings as delivered in this country and in Germany to the discredit of the former, and considered that something must be done, if American machine-tool builders are to hold their own. The committee was continued.

Claims for Defects

The next report was from the committee on claims of buyers against manufacturers, and was presented by its chairman, Mr. Shipley. The report related to claims for deficiencies and inaccuracies in machine tools and recommended that when such claims are found to be well founded, all expenses connected with their correction should be borne by the manufacturer, while expenses incurred in investigating claims that are not substantiated should be paid by the customer. The report was accepted with the recommendation that the practice advocated be adopted.

Uniform Contracts with Customers

Following this came the report of the committee on uniform contracts with customers, whether made by manufacturers directly or by their agents, and it related to a proposed uniform sales-contract form to be used by both the manufacturer and his agent. It was recommended that this contract should provide for the retention of the title to the machine by the manufacturer until completely paid for, and it took up the question of cancellation of orders, which has become a burning one during the present depression. It was pointed out that the practice of canceling orders at will is peculiar to the machine-tool trade, and the committee urged that this condition could be improved by united action in this line of business as it has already been improved in others. It was pointed out by Mr. Bullard that in one case within his knowledge an automobile manufacturer had canceled orders for the entire equipment of a factory, but that when asked about his practice regarding his own sales, he had blandly replied that all such sales were protected by an initial payment of 20 per cent. of the contract price.

The report was accepted and the committee continued with instructions to confer with the committee of the dealers' association and endeavor to perfect a contract form covering both subjects.

Freight Charges

The next report was from the committee on freight charges and was presented by its chairman, Mr. LeBlond. The committee had taken up the grievances of the members in connection with unjust charges connected with excess carload shipments and had corresponded with the uniform freight classification committee and with the interstate commerce commission. It had, however, succeeded in accomplishing nothing and it could only recommend agitation among other commercial and manufacturing organizations, whose members had similar grievances. The committee was continued and instructed to carry on such a campaign with the view of bringing about united action before the interstate commerce commission by all of the leading interests affected by the present injustices of the railroad companies.

Revision of the Constitution

The next and last report was from the resolutions committee who recommended the appointment of a committee to revise that clause of the constitution which defines the eligibility of members, as it has been found that this clause is not sufficiently definite. It also offered a resolution providing for arbitration of disputes between members by a committee of the association, such arbitration being believed to be less expensive and more satisfactory than litigation. Both resolutions were adopted.

Following this, J. H. Cone, representing the National Metal Trades Association addressed the meeting by special permission on behalf of the coöperative system of engineering education as now practiced by the University of Cincinnati and the manufacturers of the same city. Mr. Cone gave an enthusiastic endorsement of the workings of the system and stated that there are excellent probabilities that it will be adopted in the near future by the Massachusetts Institute of Technology and by the Worcester Polytechnic Institute.

Following Mr. Cone, Mr. Franklin made some additional explanatory remarks regarding the uniform system of cost accounting on which his firm had reported, and, following this, the convention adjourned.

It has been the privilege of the writer to attend nearly all of the meetings of this association since its organization and it has been of much interest to watch its progress from the first meeting, which was brought about by a scarcely defined feeling that such an association should be formed, but without any clear idea of what it had to do, down through the successive stages in which it has "found itself" with a full and fruitful program for action. The present meeting was by far the best that has been held, and we believe that no machine-tool builder outside of the association could have listened to its proceedings without recognizing its large importance to the industry and to himself. Its work has been largely educational, but it has been more than this. The subject of uniform cost accounting, which was brought to such a successful conclusion at this meeting, although, when first suggested useful results were believed by most to be impossible, and the subject of cancellation of orders opened up at this meeting are alone sufficient to justify the existence of the association. As time goes on, its field of activity constantly enlarges and there can be no question that it has a useful future before it and that it deserves the support of all engaged in the industry which it represents. F. A. H.

Experiments have shown that on a clear, dark night, a light of one candlepower is plainly visible at one mile; one of three candle power at three miles; one of ten through binoculars at four miles; one of 29 at five miles, though faintly; and one of 33 candlepower at five miles without difficulty. On an exceptionally clear night, a white light of 3.2 candlepower could be distinguished at three miles; one of 5.6 at four miles, and one of 17.2 at five miles. The first experiments were made with green lights, but it was found that red lights could be seen at greater distances.

Experiments by the Danish government with windmills for electric power generation for industrial and agricultural purposes have demonstrated that those of the four-wing type are the most successful.

National Association of Manufacturers

Discussed Business Conditions, Reviewed Recent and Suggested New Legislation and Declared Belief in Speedy Return of Prosperity

EDITORIAL CORRESPONDENCE

The 13th annual meeting of the association was held at the Waldorf-Astoria, on May 18, 19 and 20. The opening session was held on the afternoon of Monday, May 18; morning and afternoon sessions on May 19, and morning and afternoon sessions on May 20, followed by a banquet in the evening.

Monday Afternoon Session

After the preliminary work of organization was finished, the reports of several committees were taken up. We quote from the report of the Committee on Interstate Commerce: "Your committee does not profess to have the complete explanation of the crisis of 1907, but it can point without serious misgivings to one factor which has certainly been unfavorable to the values of railway stocks; the attacks made against property of that kind by the legislation of some of our States. Property, even of railroads, is none the less property, and when the rights of one kind are disturbed all are involved. The 'two-cent' fare bills which have been so popular with recent State legislatures, were in many cases simple confiscation, and the effect of describing a rate at which passengers could only be carried at a constant loss to the carriers has been shown in a fall of stocks from par to less than 50 per cent. in stagnation of railway improvements and in paralysis of railway extension. The inference is clear to us that our local law-makers have not a broad enough view to be trusted with the regulations of carrying corporations. Their meddlesome interference was not, doubtless, the cause of the panic, but it has undoubtedly contributed to make bad worse. Your committee is inclined to hold State action far more responsible for this than National action. To our mind, the fashion now prevailing in some quarters of charging our financial disasters to efforts of the executive branch of the Government, to make of the Sherman and Elkins acts something better than a dead letter, and to hold great corporations to their obligations in the public service, is too absurd for serious discussion. It is a whimsy of present-day politics, to be mentioned only to be dismissed."

Inland Waterways

The report treated of the broad subject of inland waterways in the following words:

"In a report of this committee at our 1907 meeting, one or two paragraphs were found sufficient to the subject of inland waterways. Now, although the practical development of this subject is still in the future, it occupies a more conspicuous place in the consideration of our interstate commerce than ever before, and, in any discussion of plans for the extension and facilitation of such commerce demands extended treatment. The Inland Waterways Commission appointed by the President a year ago has made its investigation and reported. Public meetings have been held in several of our cities, and their proceedings published; the project has found a prominent place in the conventions of farmers and business men; the papers have given considerable space to it, and some of our most prominent statesmen have discussed it as a live issue of the day."

The three most important features of the proposed internal waterways system are thus characterized: A ship passage from the Mississippi mouth by the Illinois river to Lake Michigan; the inner line of deep canals across the Cape Cod peninsula, across New Jersey, connecting the Chesapeake bay with the Delaware at one end and Albemarle sound at the other; and the deep water connections between the Great Lakes and the Hudson river.

Industrial Education

The report of the Committee on Industrial Education dealt at considerable length, with the first meeting of the Society for the Promotion of Industrial Education, held in the early part of the year in Chicago, and then sketched in some detail some of the principal industrial training schools of the United States and the work which they are accomplishing. The closing sentence is cheering for the future: "Your committee are pleased to be able to say in closing this lengthy report that the present outlook for industrial education in the United States is brighter and more encouraging than ever before."

A supplemental report was made by E. F. DuBrul to the report of the Committee on Industrial Education, in which Mr. DuBrul outlined the work which is being done in the engineering courses of the University of Cincinnati, where the students are brought into shop work in some of the factories of the city, and made the suggestion that schools of high school grade could carry out industrial education of a character suited to the age of their pupils by arranging for coöperation between the schools and the shops in the cities or towns in which the schools were located or, in other words, carry the scheme of the University of Cincinnati into schools for industrial education.

Commercial Problems

Geo. J. Seabury read a caustic address on "Industrial and Commercial Problems and How to Promote Foreign Trade." He explained why Congress has been so remiss in the matter of ship subsidy legislation and said that foreign conspirators had been busy in the lobby at Washington and had effectively aided their Northwestern allies of this country, in defeating ship-subsidy legislation. Throughout his address Mr. Seabury brought in many personal reminiscences which were well appreciated by his audience. He also made many interjectural notes, one of which was, "It will be treason if we do not have a merchant marine pretty soon."

An address was made on "American Protection for American Industry" by Allen Ripley Foote. He was followed by Alfred H. Post, who spoke on "Export Shipping Problems." Two propositions were put forward by Mr. Post: first, a lower or different rate on goods which are intended for export is not discrimination; second, manufacturers should be allowed to combine their export shipments so as to make carload lots and receive therefor carload rates.

The last address of the afternoon was by William H. Douglas, the vice-president in America of the American Exporters' and Importers' Association on "Exporting." It was a request for better understanding between the exporter and the manufacturer and two requests were made: Change the method of invoicing so that all goods billed between the first and last days of any month will be subject to a discount of 2 per cent, or whatever per cent. may be agreed upon for cash, if the account is settled on or before the fifteenth of the following month; and, give the commission exporting houses exactly the same terms and same treatment as is accorded to foreign buyers of the same goods.

Tuesday Morning Session

This session was taken up with the presentation of reports. From the report of the Committee on Child Labor we quote: "During the past year (1907) new laws relative to child labor and improvements of present laws have been passed by the legislatures of 23 States. As far as noted, all of these laws have been steps in advance for the betterment of conditions in

the various States. In a number of States the age limit is still below 14 years, and in 13 States the law permits the employment of children who are 12 years of age."

The closing paragraph of this report is also worthy of quotation. It is: "The child of today is the man of tomorrow, and there is no more vital question before us than that of seeing that the children who are obliged to work are given their protection which, while ministering to their advancement in mind and body, will not fail to inculcate in them the spirit of industry that will make them the most useful men and women in the world. It is most desirable that such laws should be enacted as will protect the child, but the greatest care should be exercised that the results should not be a stifling of the spirit of industry in the young of America."

An interesting and stirring address was delivered by George H. Maxwell on "The Sources of the Nation's Wealth." Mr. Maxwell briefly reviewed the efforts which are being made toward the improving of the great waterways of this country, and then set forth clearly the connection between irrigation and the control of rainfall and their influence upon the water supply for our great rivers.

Tuesday Afternoon Session

At this session a report was received from the Committee on Patents. It is well known that the great volume of business in the patent office results in some hasty actions.

We quote: "Unless the force can be enlarged and the salaries materially increased, the whole system of examination will become practically worthless."

The benefits which inventors could derive from a digest and abridgment of existing patents, is shown by the following paragraph. We quote: "Again, there is greatly needed for the benefit of inventors a proper system of classified digest or abridgment of patents. These can only be prepared by men of special skill and training. They would enable the inventor or manufacturer interested in any particular invention or subject to easily ascertain not only the original state of the art, but the important features of all patents issued. This would prevent the filing of useless applications, and would lead to the presentation of applications in such form as to greatly reduce the work of the examining corps."

The patent laws under which we are now working were framed many years ago, and have had extensive interpretation by the courts. During the present session of Congress several bills have been issued in the nature of amendments to our patent laws. The attitude of the committee in regard to these amendments is thus stated: "In conclusion, it is respectfully submitted that this association voices its disapproval of the various amendments above referred to, and that it should indorse the bill for the establishment of a court of patent appeals and urge upon the President of the United States and upon the two houses Congress more liberal appropriations for the patent office, to the end that the force may be enlarged, the salaries increased and the records completed so that reliable examinations may be made and the law properly carried into effect."

Tariff and Reciprocity

An extended discussion took place over the report of the Committee on Tariff and Reciprocity. The report of the majority of the committee declared for a board of tariff experts. A minority report was given written from the hard-shelled standpoint of protection. Both of these reports were accepted by the convention and the discussion turned upon three resolutions which formed a part of the report of the majority of the committee. These resolutions as finally adopted are:

Resolved, (1) We emphasize the importance of maintaining a principle of protection for American industries, of farm, factory and labor.

Resolved, (2) We recommend to Congress the creation of a permanent semi-judicial tariff commission or board of experts which shall investigate thoroughly and scientifically all matters pertaining to the subject, to the end that Congress and the Executive may be fully informed and shall assist the State department when desired, in the formulation and negotiation of treaties of reciprocity.

Resolved, (3) We recommend as the basis of protective duties upon which the commission shall work, the principles of international cost, to wit: Protective duties should represent "substantially the permanent difference between the cost of production in foreign countries and that in the United States with an ample margin of safety to cover possible contingencies."

Immigration

The report of the Committee on Immigration drew the distinction between the immigration which came from Europe in the early days of this country and that which we are now getting, in the following paragraph. "Then only the sturdiest of humanity undertook to leave Europe whence the great bulk of our immigration has come, for the purpose of seeking a new country where there was freedom and opportunity. Now the country has grown rich, there is a strong tendency among a very inferior class of Europeans to come to this country."

The scope of the present immigration law, and the results which might be expected from it if it were properly enforced were also touched upon. "Under the present law, skilled labor may be even helped to come to this country provided labor of like kind unemployed cannot be found in this country.

"The existing laws properly enforced would exlude many anarchists and socialists who are now admitted, and would let in many good people heretofore legally excluded."

Merchant Marine

The report of the Committee on Merchant Marine, after stating that American shipping upon the deep seas between America and foreign countries is continually retrograding, sets forth four reasons why we have fewer ships engaged in foreign commerce. We read:

(1) "The standard of living for American seamen is higher than that for foreign seamen.

(2) "The foreign countries which are handling the deep-sea shipping of the world all give liberal compensations which we call subsidies.

(3) "There are many direct subsidies. England and Germany pay very large direct subsidies.

(4) "Much of the railway system in Germany is owned and operated by the government. The government gives a much better freight rate on the railways to German ship lines on goods that are handled over the high seas on German ships and the rates given to overland traffic, than that given to traffic which comes from ships of other countries."

One of the addresses of the afternoon was given by Judge William H. Speer, of New Jersey. He spoke of the efforts being made at Washington to pass anti-injunction legislation. He stated that some of the bills were recognized by all of his hearers as pernicious, while others, which superficially seemed harmless, were, however, harmful because of their source, and because they would tend to give momentum for other more drastic legislation in the future. Speaking of classes and class legislation in this country he pointed out that there are only two classes in America, and these two have always existed; they are, the class of righteousness and the class of unrighteousness, the class which believes in law and order and the class which believes in turmoil and disorder.

Consular Service

The second address was given by William McCarroll, representative of the George Washington University, of Washington, D. C. This university is making efforts to establish special courses to train young men for the consular service. Mr. McCarroll set forth the need of such specially trained young men; spoke of the efforts which had been made to place the consular service on the merit or civil-service basis, and made an appeal for further legislation to more firmly take our consular service away from the sway of the spoils system.

National Incorporation

The report of the Committee on National Incorporation declared for a na-

tional incorporation law applying to all interstate corporations and suggested that it was too great a power to place in the hands of any one man to have his appointees the censors of what was and what wasn't a good corporation.

Resolutions were passed condemning the proposed increase of freight rates, unless the railroads shall first submit the case to the Interstate Commerce Commission for adjudication; calling upon Speaker Cannon to oppose the anti-injunction legislation and commending Representative Charles E. Littlefield for the stand he has taken on matters affecting labor legislation.

Wednesday Morning Session

The reports of three committees were taken up, namely: Banking, Postal Affairs and Pure Food. None of them provoked discussion. The gist of the report on bankruptcy is embodied in the following resolutions:

"Whereas, The National Bankruptcy act of 1898 is a far better law than was any of its three predecessors, and has more than met the expectations of its framers; and

"Whereas, By giving balance and stability to business during the money scare of the last two and a half months of 1907, it saved thousands of tradesmen from financial ruin, and thus insures us a speedy return to normal conditions; now, therefore, be it

"Resolved, That the National Association of Manufacturers will combat all attempts to repeal this act regardless of the quarter from which the act is assailed or the pretext on which repeal is demanded; and, be it further

"Resolved, That experience under this statute has shown that amendments in a few places are desirable in order that it may more fully meet the honest business demands of the day; and, be it further

"Resolved, That the National Association of Manufacturers stand ready to coöperate with every other organization which seeks to change the law along sane and conservative lines."

Postal Affairs

In the report on Postal Affairs, the committee touches upon the lack of continuity of service of the executives of the Post-Office Department. We read:

"It is interesting to note that one recommendation of your committee in its report of last year is recommended by the expert accountants employed by the commission [joint commission authorized by Congress on March 2, 1907, to investigate the business system of the Post-Office Department and the Postal Service] and that the commission itself is profoundly impressed with the recommendation. That the actual direction of the business of the Post-Office Department and Postal Service be committed to an officer with necessary assistants to be appointed by the President, with the advice and consent of the Senate, for long terms, so as to insure the continuity of efficient service, and that the Postmaster General as a member of the Cabinet be chargeable only with general supervisionary control, and the determination of questions of policy."

Pure Food

The report of the Committee on Pure Food was written in a cheerful vein and notes that marked strides have been made during the last year in the cause of protection of our people against fraudulent branding of foods, and the use of injurious substances in foods. Two agencies have been at work to bring about this commendable result, and they are thus characterized:

"First, the officials charged of the enforcement of the National Food Law have settled many vexed questions to the satisfaction of consumer, dealer and manufacturer, and the question of what is the proper label for given foods is fairly well determined. The greater question, however—relating to the permissibility of certain preservatives, whose use has been sanctioned by the necessity since the appearance of certain foods upon the market—has not been satisfactorily determined for the reason which will be referred to later. Second, the State food laws of many States have been remodeled and as a rule improved so that the State control of food products may be said to be in a more satisfactory condition than ever before. The individual States acting under their police authorities have shown a disposition to legislate more in harmony with the spirit of the letter of the National Food Law. This begets the hope of eventual uniformity throughout the United States as to labels and manufacturing requirements."

The reason why certain preservatives for foods have not been satisfactorily passed upon is that the question of their fitness or unfitness is purely a scientific one and must be determined by scientists who are fitted by education, training and experience to deal with such matters. The action of the President of the United States in securing the appointment of a board of scientific review is commended on the grounds that it "is fully warranted by the exigencies of the question at issue."

Fire Prevention

Powell Evans addressed the convention on the subject of fire prevention. He pointed out that the fire loss in the United States is nine times greater per capita than in any of the principal industrial nations of Europe. The present rate averaged from the last few years is an annual loss of $198,000,000. Two things which should be associated are the use of timber for building purposes in municipalities and the decrease of our available timber supply. The restrictions of the use of wood would accomplish two results: the reducing of the fire risk in the area occupied by such buildings (not built of wood) and the conserving of our timber supply. Mr. Evans urged upon the association the appointment of a committee to take up the broad subject of fire prevention and protection.

The most lengthy address of the morning was by James A. Emery, general counsel of the Council for Industrial Defense. His subject was "The Legislative Situation." At some length he discussed the attempted and enacted legislation at Washington during the past year, and important judicial decisions dealing with labor matters and with the relations between employers and employees. The various anti-injunction bills were reviewed; a brief history was given of their origin and the results which they had met with at the hands of both branches of Congress. Recent decisions of the Supreme Court as affecting the rights of labor unions was discussed, and the history of the Sherman act was given in detail.

Wednesday Afternoon Session

The final business session was opened by an address by C. C. Hanch, of Indianapolis, on the one-price system.

He was followed by Clifford Pinchot, chief of the United States Bureau of Forestry, who addressed the convention on the preservation of our great natural resources, and in particular the preservation of the forests.

Resolutions were passed commending reports of the Committee on Industrial Education, and asking all of the members of the association to coöperate in the industrial education movement. Another resolution related to reform legislation dealing with child labor, the regulation of the railroads and actions favorable to labor unions. An attempt was made to have the same resolution deprecate the advance of the prohibition movement, but without success. This resolution was offered in an unmistakable "let us alone" spirit. President Van Cleave was then elected to succeed himself as president of the association for the ensuing year.

The Closing Banquet

The banquet in the evening was the concluding function of the convention. The slogan given to the members by their president was, "Not capital against labor, but order against chaos." The toastmaster, Ludwig Nissen, in his introductory remarks, gave this injunction: "We have been hearing something of hard times. They are going to change and change soon, and when this banquet adjourns and the members of this association go to their homes, it is the duty of every man to tell everyone he meets that the hard times are at an end and this country is on the verge of a great prosperity."

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Pneumatic Chuck

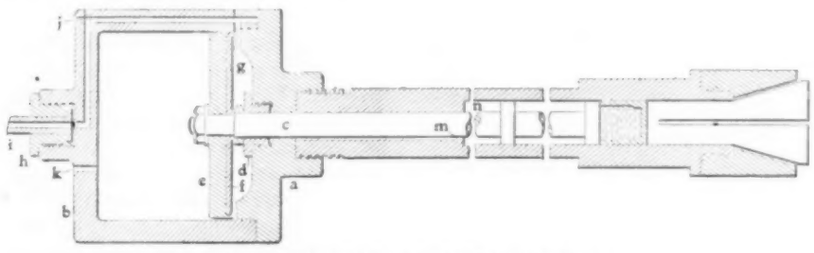
The following is an air chuck for use on monitors in place of the usual lever on draw-in chucks. It may be used on castings or any work that does not require an open spindle. One with a 5½-inch bore, used at 75 pounds air pressure, will be found large enough for average size work in brass. This size is strong enough for the use of a 2-inch pipe tap.

Referring to the sketch, which shows it on a lathe spindle connected up, the cast-iron body *a* is threaded to screw on the end of the spindle. The other side is threaded for the cast-iron cap *b*, which should be bored accurate and highly polished. The body is bored a sliding fit for the draw rod *c* and bored and threaded for the nut *d*. This chamber and the end of the nut should be tapered, on the face, as in sketch and used as a packing box, preventing the escape of air into the spindle.

The piston consists of the cast-iron plates *e* and *f* with the leather cup disk *g* between them. The plate *e* should be a loose sliding fit, the leather disk serving as the air check. The end of the cap is bored and threaded for the nut *h* which is bored, and the end tapered and fitted with the brass nipple *i*, the taper of which is ground to the nut; *j* is the air passage drilled through from the outside, running from the nipple chamber to the body bringing the air back of the piston. The holes in the outside are plugged with small studs screwed in, at *k* is a small hole to allow the air to escape as the piston moves. The drawing rod *c* is fitted in the spindle as usual in this style of machine, with the key *m* fitting the keyway inside of the spindle, and a coil spring at *n*, to draw back the rod when the air is released.

The short brass nipple *i*, is fitted to a union and the air pipe which can run down in front of the machine and at a convenient position the cut-off cock may be inserted. A plug cock with a waste hole drilled in one side through both body and key may be used. This waste hole is to allow the compressed air to escape from the cylinder as the cock is turned off.

Freeport, Ill. EXPERIMENTER.



PNEUMATIC CHUCK FOR SCREW MACHINE

An Expanding Square Hole

Up in Syracuse the other day I ran across a little wooden model which interested me because of its simplicity and also because of the possible uses to which it might be put. The line cuts show what it is like. On the base *I* four strips *E, F, G, H* are nailed. The four triangles *A, B, C, D* slide on each other and on the strips *E, F, G, H*, which back them up, preventing their being forced away from the center. With the model I have, after rubbing the triangles with black lead, I can, by pushing the two opposite triangles, open or close the square hole in the center. It is possible some fellow may make use of this for a tap wrench some day.

E. A. DIXLE.

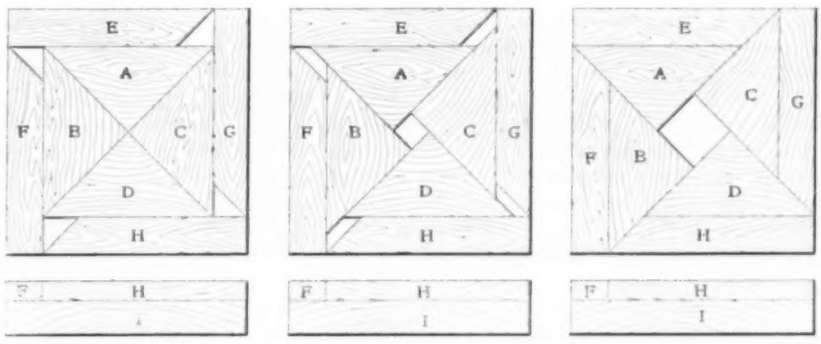


FIG. 1 FIG. 2 FIG. 3

AN EXPANDING SQUARE HOLE

Circular Forming Tools

The application of mathematical principles to the making of circular forming tools, will in many, if not most cases, obviate the necessity of making a forming tool, and produce a job whose accuracy will be unassailable, if we eliminate the slight distortion of the steel due to hardening and tempering, which must be considered, no matter what method may be used to produce the tool.

Our first step must be to figure out the cutter, which must also be the first step even though a forming tool be used.

By referring to Fig. 1 it is evident $a\,b = c\,b = \frac{d'}{2}$, or the radius of the circle.

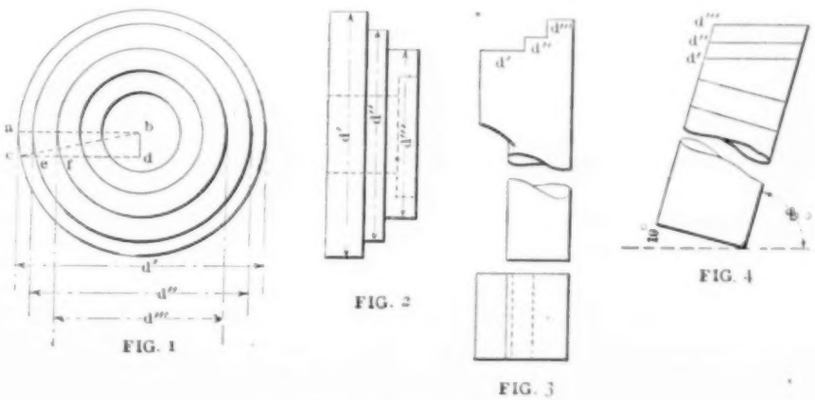


FIG. 1 FIG. 2 FIG. 3 FIG. 4

CALCULATING CIRCULAR FORMING TOOLS

Now let us transpose this line and ascertain the length of $c\,d$, which is drawn a distance below the center, equal to the distance the tool is cut off the center $= b\,d$, and at a right angle to $a\,b$, also to $c\,d$. Therefore $c\,d$ must equal

$$\sqrt{(a\,b)^2 - (b\,d)^2}\,.$$

This result will constitute our starting point. $c\,d$ diminished by one-half the difference between the smaller diameter of the work required, and the next larger size adjacent, will give us $e\,d$. But as we cannot accurately measure this distance except on the center, we will transpose this, and find d'', which equals

$$2\sqrt{(e\,d)^2 + (b\,d)^2}\,.$$

Having now found d'', we proceed in a like manner to find d''', that is, diminish $c\,d$ by an amount equal to one-half the difference in the two required sizes, and then $d''' =$

$$2\sqrt{(f\,d)^2 + (b\,d)^2}\,,$$

and so on.

Now a word in reference to forming tools. It is often advantageous to use such a tool owing to irregular shapes, and even where straight cuts exist, but which may be so narrow the workman cannot get at it with a micrometer, or other instrument of precision.

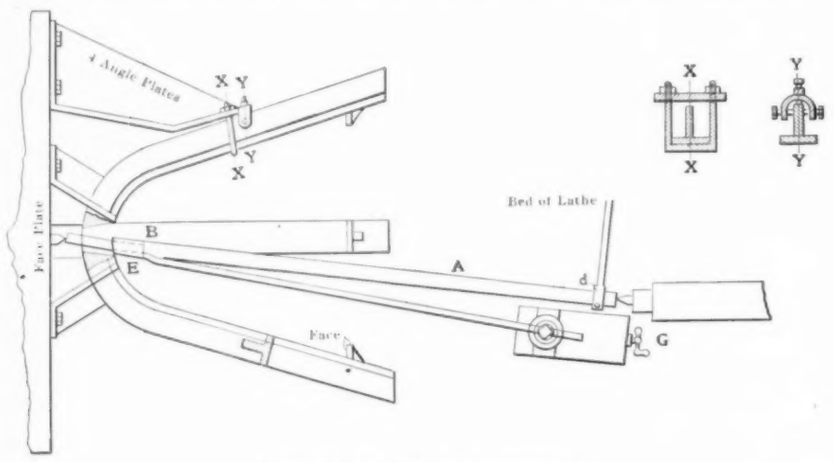
We first carefully machine the tool on all sides, to insure its standing square when in the lathe, then incline it at an angle, as in Fig. 4. I use the angle of the cutting edges d''', d'', d', 10 degrees with satisfactory results. It will appear at once to the careful observer, that if we make the depth of our cut, Fig. 4, d''' to d'' we will be too deep as the tool is standing at an angle. Hence we must make the depth of the cut, Fig. 1,

$$\frac{d^2 - d^{2\,1}}{2}$$

× cosine of the angle at which the tool sets, if 10 degrees be used the constant would be 0.9848. This form of tool will enable a workman to produce an indefinite number of screw-machine cutters, as all it requires to sharpen is to grind the top parallel with the bottom. It must be remembered that in using this forming tool it must be set at the center, and level with the ways of the lathe.

JOHN C. RICHARDSON.

Rochester, N. Y.



A BORING BAR FOR BELL HOUSINGS

A Rigid Boring Bar for Bell Housings

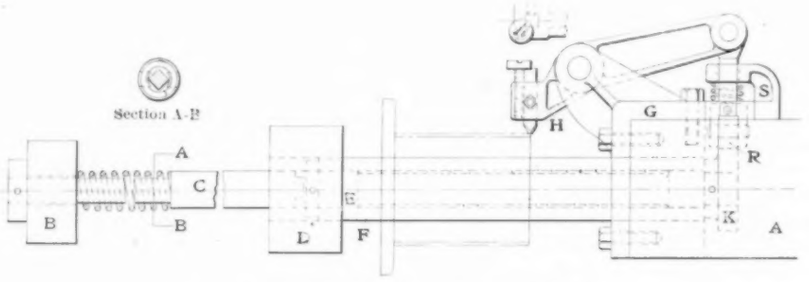
The accompanying engraving shows a boring bar designed primarily to machine the tapered hole in bell housings. Owing to the shape of the casting it was impossible to get the tool nearer to the hole than a distance of about three feet. The ordinary type of boring tool was very springy when used under these conditions, and, therefore, the tool illustrated was designed in order to gain in rigidity.

The device consists of the bar A carried on centers and set at an angle corresponding with the taper of the hole to be bored. The part B is a sliding collar keyed to the bar A, having at its front end a slot and set-screw to hold a cutting tool E, and at the other end a slot for the bar C. A clamp D is fastened to the bar A and engages with the bed of the lathe so as to prevent any rotation of the bar. The bar C is held in the compound rest which is set at an angle corresponding with the taper of the hole to be bored. The tool is fed by means of the screw in the compound rest acting through the bar C and the collar B. Thus the tool is fed by parts independent of the bar A, and as the tool is supported by the collar B and the bar A the device is very rigid.

The housing is held to the face plate of the lathe by means of four angle plates whose clamping devices are well shown by the sections $A\,A$ and $B\,B$.

A Turret-lathe Tool for Turning Piston Rings

Generally speaking, piston rings for small gas engines are made of cast iron and are cut from a cylindrical casting having cast-on lugs to hold it while chucking. The form of these castings is much the same, but there are various ways of turning the rings eccentric.



A TURRET LATHE TOOL FOR TURNING PISTON RINGS

The accompanying figure shows one method which has some good points. A few words will suffice to make it clear. The fixture is used on a standard Potter & Johnston turret lathe. The turret is represented at A. The bushing B is pressed into the end of the lathe spindle and has a square hole in which the rod C works. The taper bushing D fits the recess provided in the chuck of the machine and is held in place by three screws, not shown. This bushing is bored out for a running fit for the pilot F which fits the hole in the turret, where it is firmly clamped. The pilot is bored out for its entire length and the shaft E is made a running fit therein, bearing only for about 1½ inches at each end, and thus avoiding excessive friction. The portion of E projecting into the hollow center of the turret is shouldered down slightly and the driving cam K is pinned to it. The bracket G and the rocker arm H are self explanatory. The spring S merely serves to keep the roller R against the cam K at all times.

The fixture works as follows: On advancing the turret the pilot F enters the bushing in the chuck D and the clutch blocks on the end of the shaft E engage with those on the end of the shaft C, which is turning with the motion of the spindle of the machine being driven by the bushing B. This drives the cam K which is made eccentric according to the amount of eccentricity required in the rings. The cam in turn actuates the push rod which rocks the arm H. The leverage is three to one, so the amount of

eccentricity of the cam must be three times as great as that desired on the rings. This large leverage also makes it three times as easy for the cam to operate the rocker arm.

The fixture works satisfactorily and has the advantage of having a positive action all the way through, as it does not depend on the force of a spring to hold the tool to its work. M. R. KAVANAGH.

Detroit, Mich.

Simple Wrench Dies

We have quite a number of heavy wrenches to make in our works and as the demand for them is intermittent, the firm did not wish to make any elaborate dies. I had the problem of three sizes to make on the one die, but overcame that after a little thought, and the wrenches are as nicely made and the two larger sizes look as good as the smallest, yet the forming die is for the smaller. Figs. 1, 2 and 3 show the wrenches as made, Fig. 4 the jaw form, Fig. 5 the shears and Fig. 6 the form to spread the larger sizes. It will be noticed that Fig. 4 has an opening in front at *a*; this is to allow for extra stock and keep it from spreading over the form, causing a bad job and considerable extra work. This die should be finished smooth and kept doped with oil and all corners rounded off. The smoother the die is, the smoother the job comes out of it. Fig. 5 has to be quite heavy to stand the work, as the 3⅛-inch jaw is 1⅜ inches thick when sheared out. I used 1½x2-inch tool-steel for top and bottom and it works well and does a nice smooth job of shearing. The ⅞-inch rivet is extended out on one side 6 inches for a handle to steady it on the hammer die. The jaws should work freely and not bind and the cutting edge given an oil dip at a low heat. Fig. 6 is a duplicate of Fig. 4, except it is larger, of course, and has a hole for a drift to be driven through to spread the jaws. Fig. 4 has a tit to spread the stock as shown. These wrenches are made in two heats, are used for rail benders, scrap pieces are used for making them and consequently I hit on quite a good thing for our works in designing the tools. Smaller sizes can be made the same way and the tools are handy to have for any shop using wrenches to any extent. T. TOOT.

Kingston, Ontario, Canada.

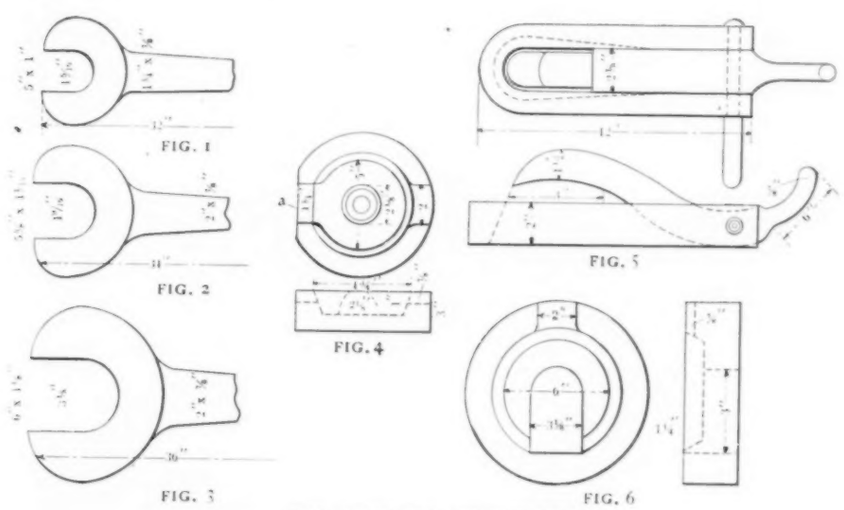


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

THE WRENCHES AND THE DIES

Straightening Bent Shafting

Having considerable experience straightening round stock such as shafts and cold-rolled stock, I have been in a position to notice that nine machinists out of ten fail to straighten, or at best fail to straighten in a reasonable length of time round stock with two or more kinks in it. Of course, there are many ways and devices for straightening round stock, but I will call attention to three of the most important, namely, with pinch-bar in the lathe; with soft metal hammer and block; in straightening machine.

The two latter ways require less skill than in the lathe, but when once the logic of straightening in a lathe is comprehended by a machinist it is by far the best and quickest way for shafts up to 1½ inches diameter. It eliminates handling to a great extent. Of course, judgment should be used to procure a lathe of suitable capacity. I have seen a lathe used for nothing but straightening for months at a time with no sign whatever of throwing the centers out of true. Shafts of larger diameter may be peened in a lathe, but it is preferable to straighten them in a straightening machine. My object is to treat on the lathe-straightening process which requires the more skill but is more easily and economically done when once mastered.

Before going into detail on straightening it might be well to briefly mention

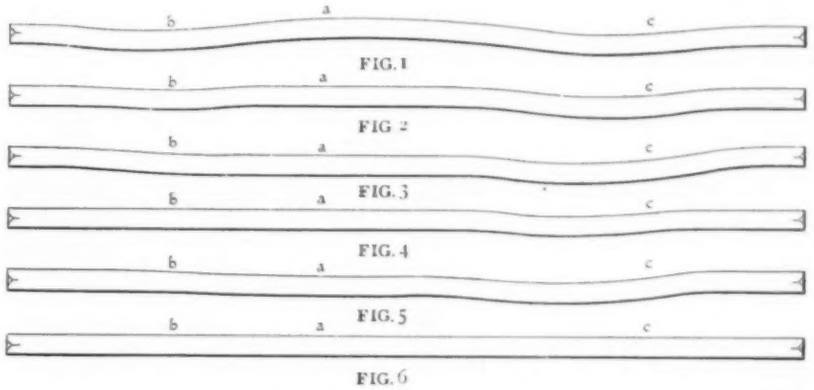


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

STRAIGHTENING BENT SHAFTING

centering kinked shafts, assuming that the shafts require centers in them. Put one end of the shaft in the lathe chuck true, or nearly so, run the other end in the center rest, with the jaws of the rest next to the tailstock flush with the end of the shaft. This insures a perfect center when centering, taking it for granted all the shafts are kinked.

After being centered remove the center rest from the lathe and proceed to straighten as follows: Swing the shaft on the centers of the lathe; if the shaft is 1 inch or under in diameter it may be turned for marking by running the palm of the hand across it. When marking in larger shafting a dog is needed in connection with the drive plate so the shaft can be run with power of the lathe.

After chalking or marking the shaft at *a* in Fig. 1, which is the greatest bend in the shaft (in all cases start with the greatest bend first), spring *a* true as in Fig. 2; do not spring *b* until *a* is thrown out the same way as *b*, as in Fig. 3. Now spring *b* true as in Fig. 4, and *a* will follow true with *b*, which is seen in Fig. 4. We have now rid ourselves of two kinks, which leaves *c* to be straightened. Of course, *c* did not come straight because the bend was greater than *b*, as will be seen in Fig. 1. Do not spring *c* until *b a* (which have become as one) is thrown out the same way as *c* as in Fig. 5. Spring *c* true and *b a* will follow true with *c*, as in Fig. 6.

It is not possible to tell how much to spring the shaft each time, as it is a matter of judgment and practice, which becomes almost second nature. In all cases, no matter how many kinks there may be in the shaft or shafts, always start with the greatest kink first, then each adjoining kink in succession either at the right or left of starting point, which is optional. For example, if greater kink is near center of the shaft as *a* in Fig. 1, straighten all kinks, say, at the left of *a* in succession from *a*: when the left side is complete take all kinks at the right from *a* in succession.

There will be cases where the greater kink is at the end of the shaft; in such a case there is but one way to work, either toward the left or the right, whichever the case may be. If centers are not needed in a lot of shafts they may be straightened in the same manner by running one end of the shaft in the lathe chuck and the other in the center rest.

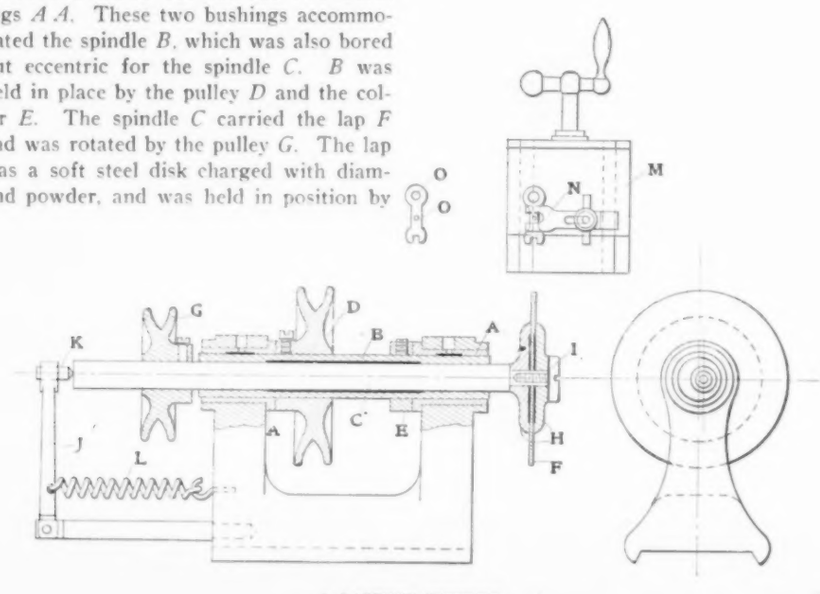
The general impression of most machinists when straightening shafting in the lathe seems to be that by springing one kink true, then another, and so on, a true shaft will result. After working some time springing one kink true, then throwing this out by trying to true another and so on, the work becomes very tedious, and if accomplished at all, it is by mere chance.

New Britain, Conn. D. W. JAMES.

A Lapping Fixture

We at one time had a large lot of small pieces approximately shaped as shown, which had to be accurately finished to size, and ground on both sides of the slot in the end of the piece. Several ideas were advanced as to grinding this slot, but the one shown was finally adopted with very satisfactory results.

An old closed tailstock casting was procured and bored out for the two bushings *A A*. These two bushings accommodated the spindle *B*, which was also bored out eccentric for the spindle *C*. *B* was held in place by the pulley *D* and the collar *E*. The spindle *C* carried the lap *F* and was rotated by the pulley *G*. The lap was a soft steel disk charged with diamond powder, and was held in position by the members *H H* and the screw *I*. The lever *J* carried a hardened steel point *K*, which was drawn against the end of the spindle *C* by the spring *L*, this arrangement serving to keep the lap pressed against the side of the slot when in use. The piece to be ground was held on the table *M* by the clamp *N*, being located by two steady pins fitted to the two holes *O O*. This table is shown in plan. The piece was then fed up to the lap by means of an ordinary screw and handle arrangement as shown. The spindle *C* was run at a high rate of speed while the eccentric bushing *B* was turned slowly around, thus feeding the lap up and down and at the same time in and out, breaking the lines caused by grinding and giving a fine polished surface. When one side was finished, the table was drawn back, the clamp loosened and slid to the right and the piece turned over and again clamped down, thus leaving it in position for grinding the other side of the slot. A stop, not shown, was provided on the table to prevent the operator from bringing the piece too close to the lap and thus having it strike the bottom of the slot. Throughout the grinding of the entire lot the only trouble given by this fixture was the recharging of the laps, which of course was unavoidable.

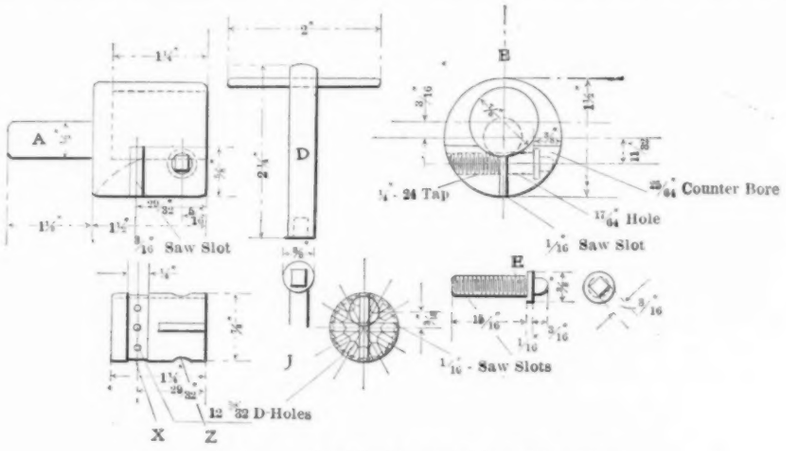


A LAPPING FIXTURE

Springfield, Ill. F. W. B.

Eccentric Chuck for Boring Tool

The accompanying sketch shows a number of parts which go to make up an adjustable eccentric boring chuck. This chuck has many points of superiority over anything I have ever seen in this line, on account of its rigidity and scope of adjustment. The sketch is shown full size, all the important dimensions being given.



DETAILS OF ECCENTRIC CHUCK FOR BORING TOOL

The body *A* is made from machine, or cold-rolled steel. *B* is an end view of the same, and shows the binding screw in place. *C* is the split internal chuck made of tool steel and tempered. The hole *J* is closed slightly in tempering so as to give a slight grip on the boring tool, thus the tool and chuck move together in the body *A* when the whole is assembled, and the binding screw *E* is loose. *X* is a ¼-inch wide groove cut 1/64 inch below the surface of the circumference, so as to give free movement of the internal chuck, there being twelve No. 31 drill holes evenly spaced around the circumference. These holes are for the adjustment, access to them being gained, when the whole is assembled, by the 3/16-inch slot shown in the body *A*.

The handle of the wrench *D* is used as the key for this purpose. The groove *Z* is cut around the circumference in the position located, so as to clear the screw *E* when the whole is assembled, this also prevents the internal chuck *C* from pulling out when the boring tool is removed.

Several sizes of boring tools can be used by having split bushings to fit the hole *J*. The screw *E* is made of tool steel and tempered, while the wrench *D* is made of machine steel case-hardened on the end. The boring tools are made of drill rod, there being usually a supply of those in most all tool rooms. The whole is a neat

compact chuck and almost indispensable in any tool room where there are a number of drill jigs, punches, dies, etc., to bore accurately.

Syracuse, N. Y. JARED.

Wax Tapers for Cores

Take equal parts of beeswax and powdered rosin, melt the wax, sprinkle in the powdered rosin and stir until well mixed. If beeswax cannot be had, use paraffin.

This composition does not soften the core as the ordinary paraffin tapers do, because the rosin goes into the core when it is baked and hardens it. If paraffin is used, it is better to make the tapers by dipping cotton wicking into the melted composition and hanging them up to cool. Redip until the tapers are of the required size. The wicking is used because the paraffin mixture is rather brittle. When beeswax is used, the wicking is not necessary, and the tapers can be formed by forcing the mixture through a small hole.

Aurora, Ill. JOHN B. SPERRY.

Jig for Drilling Spanner Holes in the Sides of Nuts

Figs. 1 and 2 show a jig for drilling the spanner holes in the nut *A* Fig. 1. The beauty of this jig is its simplicity and speed. The nut to be drilled is put

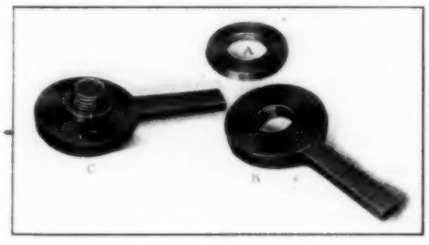


FIG. 1. THE JIG DISASSEMBLED

FIG. 2. THE JIG CLOSED

on the collar at the base of the stud *C*, Fig. 1, the side to be drilled being down, of course. The other part *B*, Fig. 1, is put right over it, then by giving it ¼ of a turn you have the nut locked in the jig for drilling. As can be seen in Fig. 1, the thread of the stud and nut are interrupted so that it only requires about ¼ of a turn to engage the whole thread. Fig. 2 shows the nut in the jig ready to be drilled.

JOHN EDW. ANDERSON.

Winchendon, Mass.

An Adjustable Pipe Tap

Owing to its taper form it is impossible to keep a pipe tap to size, especially in brass work where the thread is relieved, so some form of adjustable tap is absolutely necessary for accurate work.

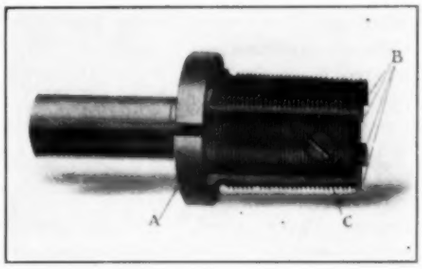


FIG. 1. PIPE TAP

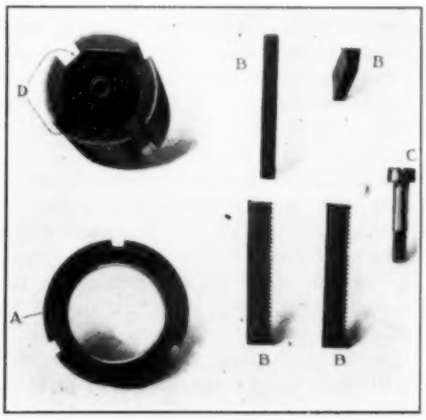


FIG. 2. PARTS OF THE TAP

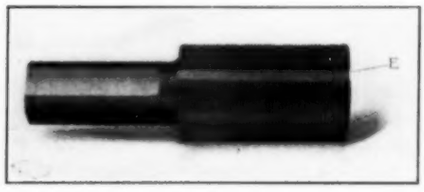


FIG. 3. THE CLAMPING SLOTS

The accompanying cuts show one of the simplest and best to be found in any shop. It is used by us on all sizes of pipe taps from ½ inch up to 4 inches.

Fig. 1 shows the assembled tap. Fig. 2 shows the separate parts. *D* shows end view of tap body and the way the slots are cut to fit the chasers. *A* is the adjusting ring, *B* are chasers which are standing on end, *C* is the clamping screw.

Fig. 3 at *E* shows how far in the slots for clamping are cut. The slots for the chasers are of course milled the regular pipe-tap taper, the chasers being parallel their whole length, so that by loosening clamp screw *C* and screwing up the ring *A*, the chasers are moved out, the dull or broken teeth ground off, the cutting relief reground and the tap is as good as new.

At the time the tap shown was made no milling saw large enough in diameter was at hand, so the slits *E* were cut with a hack saw.

Decatur, Ill. ETHAN VIALL.

Setting the Dividers Accurately

The following method of setting dividers accurately may be of interest.

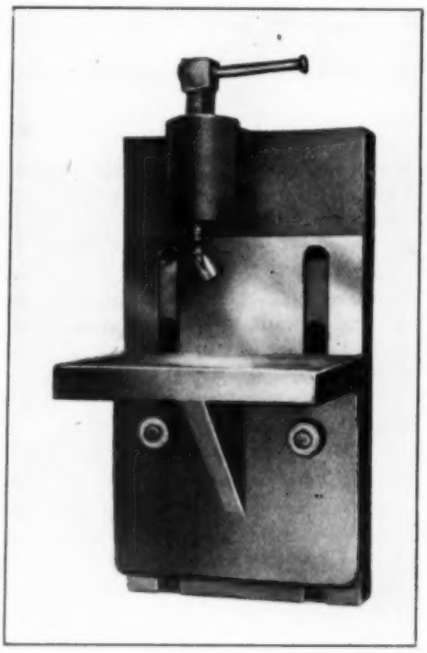
Take any caliper square made for outside and inside measurements, and on one side of the jaws with a fine prick-punch locate two dots, say 0.050 inch apart when the caliper is closed.

If the outside of the jaws measure 0.125 inch and the distance required is 0.340 inch, set the jaws using a micrometer, to 0.340 inch + 0.075 inch (or the difference between the outside of the jaws and the space between the dots), which will equal 0.415 inch and using the dots proceed to set the dividers.

Florence, Mass. GEO. A. DOPPMAN.

Fixture to Hold Rods While Drilling

The accompanying half-tone shows an angle plate designed for a drill-press



DRILL PRESS FIXTURE

fixture. It was originally planned for drilling rods with a support from the floor, and has proved very useful for all angle-plate work within its range. It has displaced the drill-press vise in many instances, as the swivel head on the clamping screw permits the work to adjust itself to the face of the angle plate.

Franklin, Penn. J. DIER.

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May 28	19,500

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Prices of Machine Tools

We believe that no portion of our report of the Proceedings of the Atlantic City Convention of the National Association Machine Tool Builders will give greater satisfaction than that which relates to the subject of prices. The only thing that can be said in favor of reduced prices is that they would stimulate demand, and it is unquestionably true that a reduction sufficient to accomplish this is impossible on the part of manufacturers, while a small reduction would only be followed by increased hesitation on the part of buyers in the belief that additional reductions would follow.

During the present conditions overhead expenses have largely increased, and if prices were to be based on current cost they would necessarily be increased. With this in view, the whole subject of prices is a very simple one. If the present condition is to continue prices, which must eventually be based upon cost, must increase; whereas if the present condition is not to continue, the manufacturer has only to hold on to his stock in order to realize at least the old prices.

The only thing that can lead to reduction is a state of panic on the part of builders, and such a state is conspicuously absent at the present time. The most striking feature of the situation is the equanimity with which it is viewed by manufacturers. So far from being in a state of panic they are universally optimistic as regards the future—a state of mind which is unquestionably due to the financially sound condition of the industry. While there has been a large expansion during recent years, the prosperity of the industry has justified this expansion, and if there is any embarrassment existing in a financial sense we have yet to hear of it.

If any member of the association went to Atlantic City in a state of uncertainty regarding the proper policy for him to follow in this matter, that uncertainty must have been removed by the interchange of views which took place. Personally we found no weak-kneed manufacturers at the convention, and if such existed their apprehensions must have been removed by the interchange of views which took place. Could those buyers who are withholding orders in anticipation of reductions have been present, they could only have concluded that their attitude will accomplish nothing, and could the temper of the manufacturers present be made widely known it could have no other effect than to bring out the suspended orders.

New Publications

THE GAS ENGINE. By F. R. Hutton. 562 6x9-inch pages and 241 illustrations. John Wiley & Sons, New York City. Price, $5.

This is the third edition of an important work and contains some new material. The reference table of gaseous fuels is especially worthy of notice. Here are given the analysis of constitution, calorific values, cubic feet of air per cubic foot of gas and combustion mixture, British thermal units per cubic foot, for 78 gases. In addition to the value of the data actually tabulated it is of direct use in determining mean effective pressures. New material is also included in regard to efficiency, guarantees, gas producers and alcohol as a fuel.

GAS POWER. By F. E. Junge. 548 6x9-inch pages, 160 illustrations. Hill Publishing Company, New York City. Price, $5.

This work is the most important recent contribution to the English technical literature of gas power. The fact that it is a critical survey of the field of gas-power generation, conversion and application in Europe does not detract from, but rather enhances, its value to American engineers. The author's preface states "the few scientific treatises available on the subject [gas power] have been devoted to either one of the three aims: The abstract study of the internal thermodynamic relations of gas-producing and converting apparatus; the quantitative side of design of their mechanism; and the historical or inventive evolution of the problem." Thus the broad economic aspect of the gas-power problem has been neglected heretofore, and Mr. Junge's searching analysis of his subject, in its bearing on these wider interests of commercial life and in its applications to industrial pursuits, places his work in the forefront of its field. He appeals to men who project, exploit and execute great industrial enterprises, that they may recognize the far-reaching importance of gas power as one of the factors in the present and future strife for industrial advancement. The work has three parts: The evolution of gas power; design and construction of large gas engines; the application of gas power. The first part devotes two short chapters to the general economic aspects of the problem and historical and analytical study and criticism of the present mode of application of gas power. The second part comprises seven chapters; the first deals with general conditions, five others deal with representative engines and their details, while the last discusses English, Belgian and American views on the design and construction of large gas engines. The third part devotes two chapters to the application of gas power in the iron and steel industries and in coal-mining and coke-making pursuits. The remaining chapter treats of the rational utilization of low-grade fuels. The growing interest in this country in the preservation of our natural resources makes this last chapter particularly opportune.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Steam Hammers with Solid Anvil

The hammer shown differs from the usual construction in having the anvil block cast with the main frame which

STEAM HAMMER WITH SOLID ANVIL

enables them to be used for light drop-forged work as well as in their usual service. The single casting preserves the alinement of dies and does away with the slight shifting of the anvil block when it is separated from the frame itself. This self-contained feature, together with the heavy frame used, requires less foundation and materially reduces the vibration to the surrounding ground. To withstand the shearing strains and the crystalization due to the constant hammering, the frames are made from open-hearth steel.

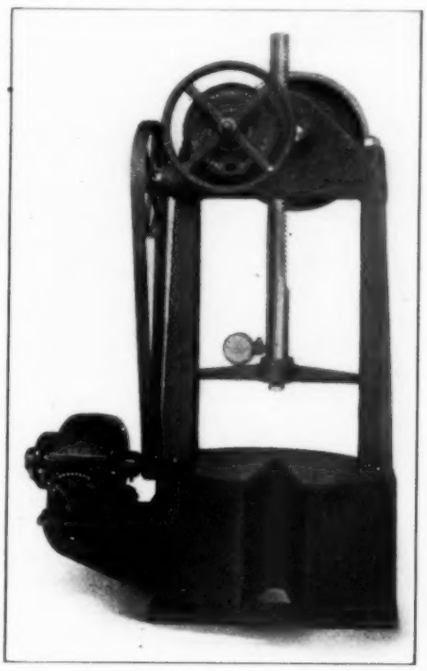
The hammer is double acting and so balanced as to be under control of the operator for either hand or foot control. In the latter case a throttle valve gives a sensitive regulation and allows the hammer to be run by the blacksmith alone if desired. This makes it suitable for dressing tools and similar work.

The guides are reinforced to stand any shearing strain due to blows struck away from the center of the dies. The cylinder is in one piece with the valve chests, is doweled and bolted to frame with fitted bolts. An automatic oil pump forces lubrication to the valves and cylinder whenever the hammer is operated. It can be run either by steam or compressed air without any change.

These hammers are rated by the actual scale weight of the falling parts without counting the force of the blow from the pressure and run from 100 to 300 pounds. These "Bell" hammers are made by the Buffalo Foundry and Machine Company, Buffalo, N. Y.

Motor-driven Forcing Press

In order to make its power forcing press entirely independent and self-contained so that it can be placed in any position without regard to a line shaft, the Lucas Machine Tool Company, Cleve-



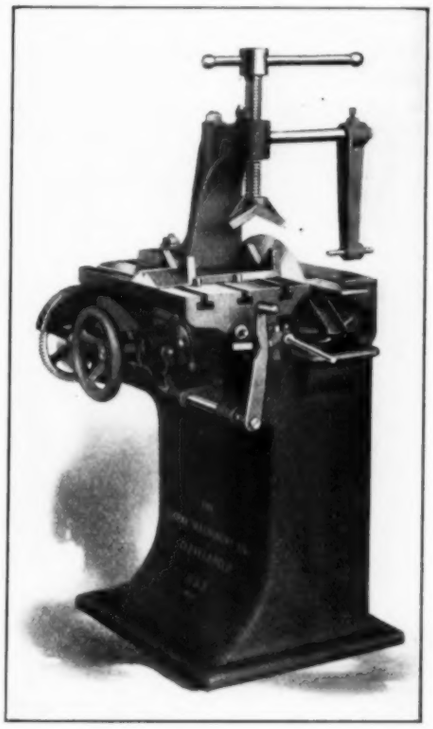
MOTOR-DRIVEN FORCING PRESS

land, O., has added a motor to its press, as shown in the acompanying illustration. The operating mechanism of the press remains the same, but for those who may not be familiar with this machine, it may be well to state that the upper pulley drives a worm and worm wheel, a pinion at the end of the worm-wheel shaft meshing into the large gear shown at the back, and this in turn drives a pinion which engages the plunger. The connection between the worm wheel and the gearing at the back is not direct, however, but through a friction, which is controlled by the large hand-wheel shown. When the ram is being run down to the work, or raised away from it, it is done by means of the hand-wheel and when it begins to do work the pressure applied is entirely controlled by the operator, who can secure any desired amount up to the capacity of the press by simply increasing or decreasing the friction of this clutch.

The small plunger in the end of the ram is a small hydraulic plunger, which is connected with the pressure gage shown, and in this way the operator knows exactly what pressure is being applied. The machine requires very little attention; all that is necessary being to replenish the glycerin in the hydraulic chamber before the shoulder on the back of the plunger touches the ram when pressure is applied. These machines are made in three sizes, having capacities of 15, 30 and 50 tons and are made in the regular form shown, or with the base below the floor for specially high work.

A New Cold Saw

This machine has been designed to meet the requirements of shops where first cost is of vital importance. The saw is mounted in a carriage, carrying a worm and worm wheel, the saw itself being



NEW COLD SAW

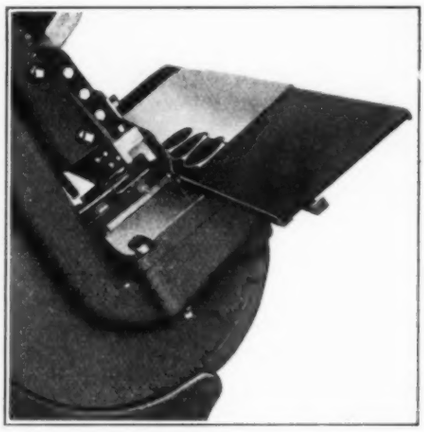
bolted directly to this worm wheel, while the worm *D* travels along its splined shaft in the same way as the feed of an engine lathe. A hardened steel casting is fastened to the front of the saw carriage, acting as a guide plate for the saw, and at the same time carrying away the chips. The work is clamped to the table by the vise shown, and the V's are provided for round and other shaped stock. There is an automatic trip which stops the carriage travel when the saw is through the cut and the stock stop *D* shown at the right is convenient in duplicating work.

The mechanism for driving the saw, and at the same time moving it along with its carriage, is all at the other end of the machine, but can be controlled by the lever shown in front. Between the driving pinion and the worm-gear shaft is a gear which drives by the friction of suitable flanges lined with leather and having a spring on the shaft, tending to force them together at all times. This acts as a safety valve to prevent the saw being fed into the stock too rapidly. The saw carriage travels over an oil pan cast in the frame of the machine so that an inch of the blade is at all times immersed in the oil, assuring constant and thorough lubrication. This machine will cut three-inch round bars, or five-inch I-beams having a maximum capacity of 3x5 inches and has a 9-inch travel for cutting flat stock. Cuts can also be made at various angles if desired. This is made by the Burk Machinery Company, Cleveland, Ohio, who also intend bringing out a larger saw on this same design.

Press Stagger-feed Attachment

This attachment can be made adjustable for different size blanks, and while devised originally for round work, can be used to a decided advantage on irregular shapes. The attachment is very simple and with it no preparatory slitting of sheets is necessary.

The sheet from which the blanks are to be cut and formed is placed on the table and fed against the first finger, which, together with the back gage on table, registers the sheet for the first cut. After this the press runs continuously, tension being kept on the sheet to bring it against the first finger which acts in a manner similar to the regular automatic finger gage. As the sheet progresses the scrap is sheared from the



STAGGER FEED ATTACHMENT

back by knives which cut a true and straight edge for gaging the back of sheet on the second run. The sheet can be run through until entirely cut up as described, the stagger finger being used alternately to start every other row of blanks. This method of cutting saves from 6 to 15 per cent. in the amount of stock used, this varying according to the size of the blank.

Two illustrations will show the saving effected. Take a sheet of tin 20x28 inches from which to cut blanks requiring a 2¾-inch diameter cut edge. By the usual method of slitting the tin into strips and then running through the press, 70 blanks would be cut. By the stagger method used in the press shown, 76 blanks are obtained from the same size sheet. In the manufacture of bottle caps for which 1½-inch cut edge is necessary, the usual method would give 234 blanks from a sheet 20x28 inches, but by this method 270 blanks are obtained from the same size sheet.

Another feature of the device is that the scrap is kept entirely separate from the blanks, and is cut into small pieces which greatly facilitates its handling. This attachment is made by the E. W. Bliss Company, Brooklyn, N. Y.

Electric Motor Chain Hoist

The handling of material is an important factor in any shop, and there are many places where the small hoist is better adapted and where its use may save the necessity for a more expensive overhead crane. In response to a considerable demand the Yale & Towne Company, New York, have equipped their Triplex hoist with an electric motor, as shown in Figs. 1 and 2. In order to avoid any undue wear on account of being motor driven, and to make the hoist thoroughly substantial in every way, they take their regular two-ton Triplex block, put on a motor and drive it by the chain shown, rating it as a one-ton hoist. This has the result of making it extremely durable, and in order to show its increased strength and wear they have prepared some interesting comparisons of wearing surfaces, tooth pressures and maximum stress per square inch of gear teeth for this block, for their regular one-ton block, and also from a one-ton block of ordinary construction.

Analyzing this we find the wearing surface of the first pinion to be nearly double

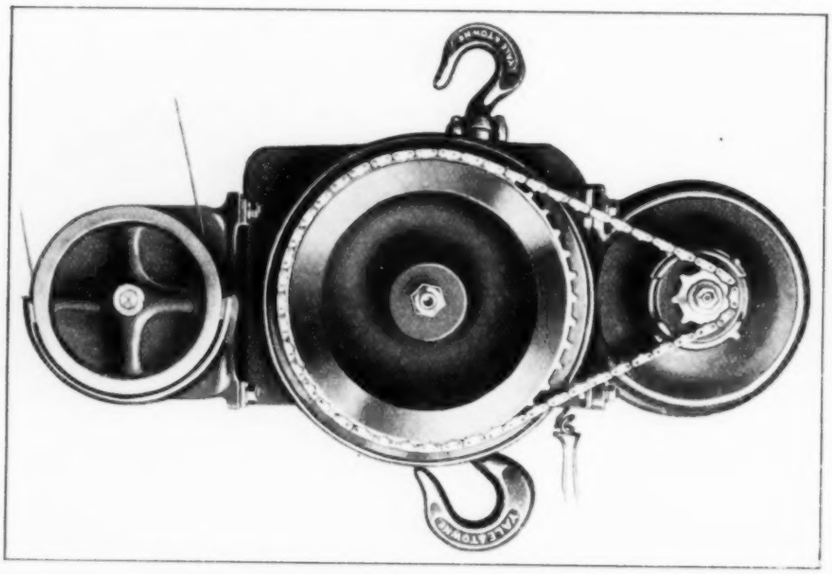


FIG. 1. SIDE VIEW OF MOTOR-DRIVEN HOIST

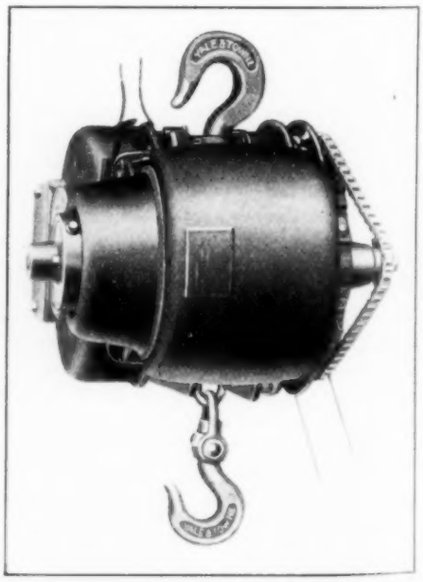


FIG. 2. END VIEW

that of their regular one-ton block and about three times that of the other. The tooth pressure is reduced to almost one-half, and the maximum stress to one-third of the ordinary block. Practically the same ratio is maintained in the second pinion, excepting that the maximum stress is reduced to about one-fifth. In the main gear the wearing surface is four times, the tooth pressure one-half and the maximum stress about one-ninth of the ordinary block. The factors of safety are 13.2, 7.5, and 3, while the cubic content of the teeth is 7.85, 4.01 and 1.42 inches, which show very plainly the wearing properties of these blocks.

The motor is of the series-wound crane type, constructed especially for varying load and speeds in hoisting work, and as a further convenience there is a hand-wheel attached to the hoist so that it may be operated by a hand chain, the same as a regular chain block, if for any reason power is not available. While designed for moderate service and short lifts, a recent test was made, in which a one-ton load was lifted 10 ft. high and lowered 30 times within two hours, this being the extreme load and a service that would hardly ever be required.

A New Plain Engine Lathe

This is a plain 16-inch engine lathe of extra-heavy design for manufacturing purposes, and differs from the usual plain engine lathe in having a quick-change attachment to all feeds, as is clearly shown in the end view.

It has four changes of belt-driven feeds and the feed can also be taken from the lead screw when a range of positive feeds is desired. The regular feeds are driven by a wide belt on two single-faced pulleys and provided with a conveniently located belt tightener. Different pitches of threads are obtained by change gears in the usual way, which also produces a change in the rate of positive feeds.

The apron is fitted with a clutch for the regular feed and has a sliding gear for the cross-feed. It also has a reverse for the feed and a safety lock for the half nut. The bed is heavy and reinforced with cross-ties, with two V-bearings for the carriage and a V and a flat for the head and tailstock. There is a large oil reservoir under each spindle bearing through which oil is supplied to the bearing itself by a wick. The main spindle bearings are of phosphor bronze, the front bearing being 3 3/16x5 inches long. The spindle has a 1 9/16-inch hole through it. Cone pulleys take a 2¼-inch belt, and are 11 inches in diameter on the largest step. This lathe is built only in the 16-inch size, but any length of bed from 6 to 16 feet can be supplied. With an 8-foot bed it weighs 2500 pounds. It is built by the Milwaukee Machine Tool Company, Milwaukee, Wis.

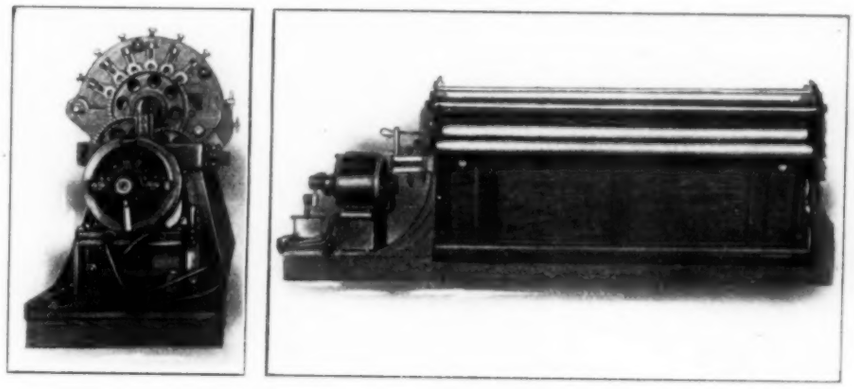
Machine for Drying Blueprints

In many drawing rooms which are equipped with electric blueprinting machines the question of drying the prints after washing becomes a serious problem and really limits the output of the office.

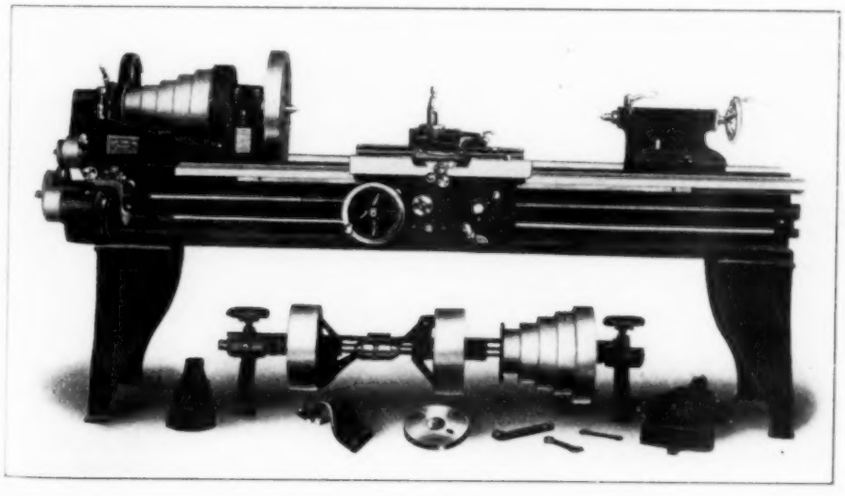
This machine has been used for some time by the American Bridge Company in their New York office, mounted at one end of a tank through which the prints pass, being sprayed as well as simply passing through the water, and are fed into the dryer as they come out of the tank. This dries and irons them as fast as they come through and enables a room of about 12x12 feet to handle 1000 to 1500 blueprints per day.

This dryer has a series of small rollers revolved by friction contact with the larger or heat roller which revolves around the heat coil. The heat wire is connected out through the center of the shaft at each end to a contact so there are no sliding or rubbing contacts. One end of the heat coil is clamped fast which holds it from turning and at the other end the shaft acts as a journal for the gearing that revolves the heat roller.

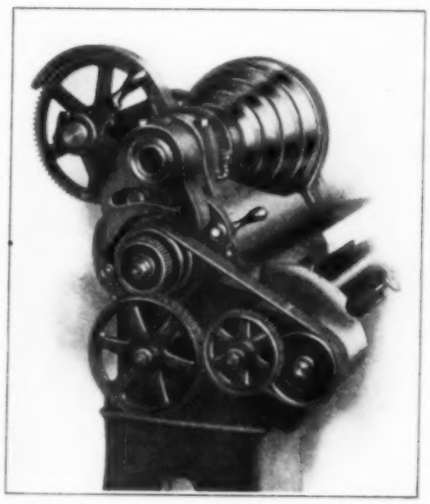
It is run by a 1/20-horse-power motor connected by a double-throw switch so that the operator can run the dryer in either direction. The rollers are turned and ground true so as to keep the paper from wrinkling. By the use of beeswax, to keep the rollers clean the prints are dried and ironed at the same time. The small top rollers are in a frame which is hinged so that by pulling out the pins they can be thrown back, then by taking out the screws in the caps holding the large heat roller the heat roller can be



MACHINE FOR DRYING BLUEPRINTS



16-INCH PLAIN ENGINE LATHE



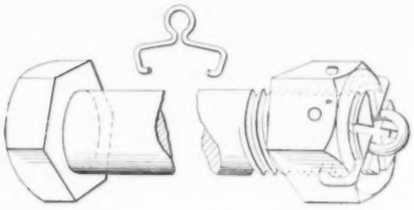
FEED GEARING OF LATHE

removed. The machine runs approximately 8 feet per minute and requires 1½ kilowatts per hour for heating.

These machines are manufactured by C. J. Toerring Company, 2121 Toronto street, Philadelphia, Penn.

A Nut Lock

As can be seen from the illustration, this nut lock consists of the small spring shown above the bolt, in connection with one or more slots across the end of the bolt, and pin holes in the flat side of the



A SIMPLE LOCK NUT

nut. After the nut has been turned down to its proper place, the spring is placed in the lock and the end sprung into the holes nearest the point, in which position it should be effectually held against loosening from jar, and also has the advantage of being easily removed. It is not possible in a nut lock of this kind, however, to lock the nut at any exact point, although by having a number of radial slots across the end of the bolt, quite a number of locking positions can be secured. This nut lock has been patented by Paul C. Schmidt, Hartford, Conn.

A Speed Box for Radial Drills

The illustration shows the speed box built by the William E. Gang Company, Cincinnati, Ohio, to attach to their radial drills and can be used on any of their drills by removing the bracket bolted to the column that supports the cone-pulley shaft and bolting the box to the column in its place.

Fig. 1 shows the arrangement of the

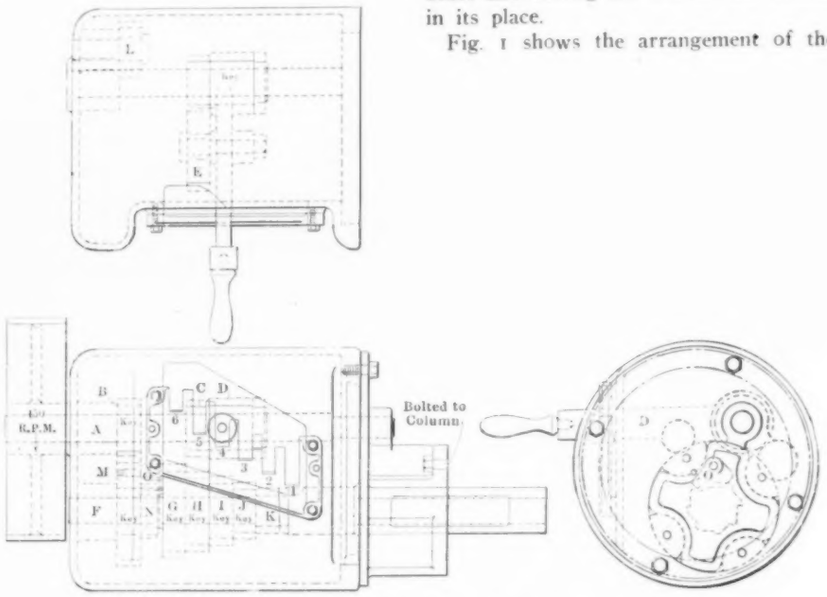


FIG. 1. DETAILS OF THE SPEED BOX

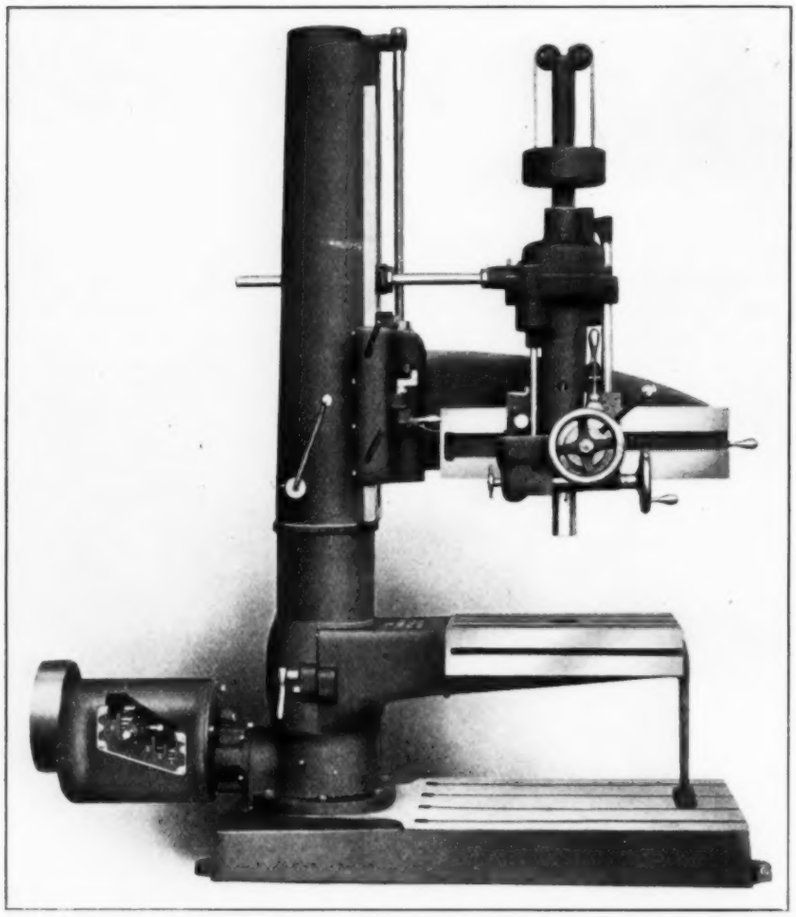


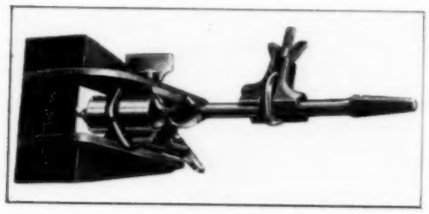
FIG. 2. RADIAL WITH SPEED BOX

gears. The driving pulley is keyed to shaft *A* to which gear *B* is keyed fast and gear *C* is driven by a sliding feather through a spline in the shaft. By means of the idler gear *E* meshing with gear *C* and carried by the handle, motion from the driving shaft can be transmitted to any of the gears *G, H, I, J, K*, all fastened to shaft *F*. Gear *B* drives *M* through the idler gear *L*; gear *M* runs upon the hub of the ratchet wheel *N* and drives *N* by the pawl *O*. The ratchet wheel *N* is keyed to shaft *F*. When gear *E* is not in mesh with any one of the train of gears, shaft *F* is driven at its slowest speed by ratchet *N*. When gear *E* is in mesh with any one of the train of gears the ratchet *N* being keyed to shaft *F* runs faster than gear *M*, and the pawl *O* is automatically lifted out of mesh by a spring. When the gear *E* is withdrawn the spring returns the pawl to mesh with the ratchet, never permitting shaft *F* to run slower than gear *M*. This arrangement does away with the shock of throwing gears into mesh while running, and also running the driving pulley at a high speed, giving increased belt power.

Fig. 2 is a photograph of the speed box in place on the machine showing the notched plate for the different positions of the lever. Six speeds are obtained from this box, which with the back gears on the head gives 12 spindle speeds. An engraved plate on the machine gives the position of the lever for all size drills within the range of the machine.

For Drilling Dowel Holes

In making core boxes and in other similar work, it is often rather difficult to lay out dowel holes in the exact location, and unless this is done, a good job may be easily spoiled. With this guide or jig, holes can be readily located by means of the angle guide shown, and this makes it impossible to bore crooked holes or for the bit to be diverted by the grain of the wood as it fits into the shell shown. There is also a stop which can be used for regulating depth, and it seems as though such a tool ought to be found very useful in almost any woodworking shop. This is made by the Roberts Dowling Jig Company, 3931 Lancaster Avenue, Philadelphia, Penn.



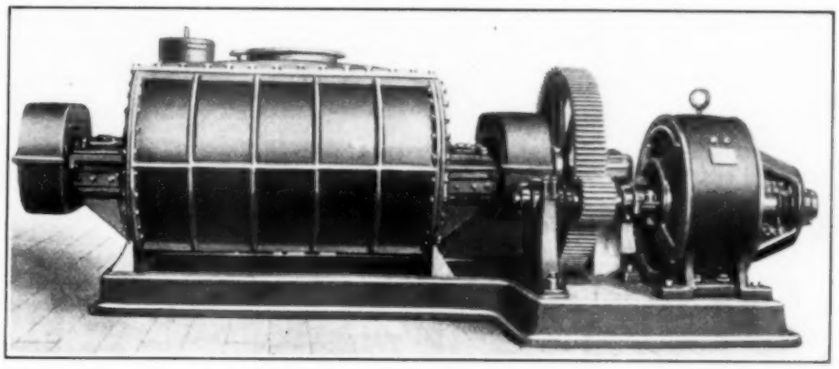
GUIDE FOR BORING DOWEL HOLES

The Cleveland Motor-driven Screw Machine

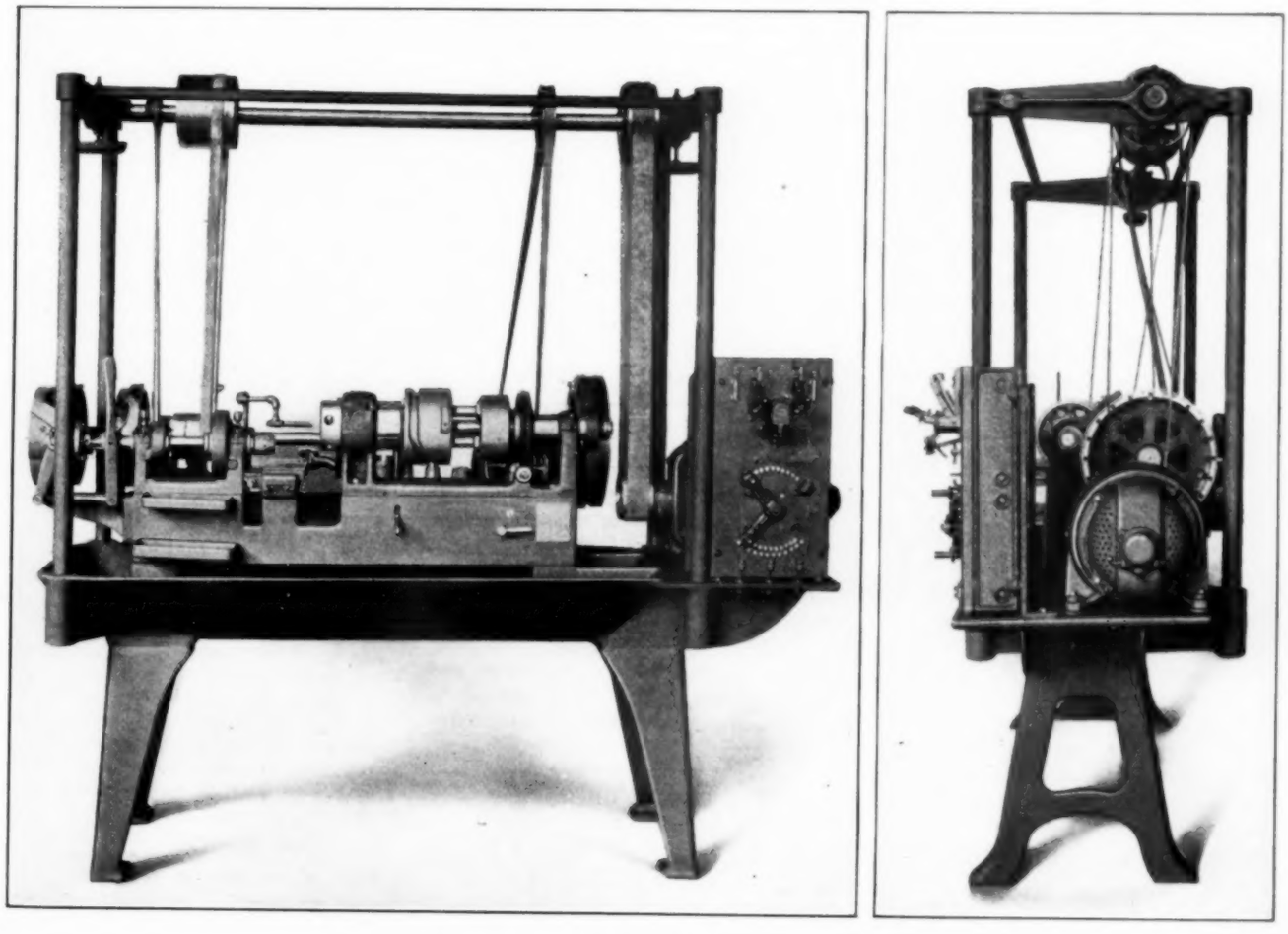
The illustrations are almost self-explanatory as they show very clearly the manner in which the Cleveland Automatic Machine Company provide for a motor drive on their screw machines. Each machine is entirely self-contained and only differs from the usual construction by having the base made for the four upright posts and with an extension to accommodate the motor and starting box. The two views show this very clearly so that no further explanation is necessary.

Motor-driven Foundry Blowers

The average foundry requires its blowers to be operated for a short time only in the afternoons, but it requires an absolutely reliable source of power in order to maintain the blast until the heat has been run off. It is therefore necessary to have the initial cost as low as possible and yet secure a reliable drive for the



MOTOR-DRIVEN FOUNDRY BLOWER



SIDE AND END VIEWS OF THE CLEVELAND MOTOR DRIVE

blower. The illustration shows a Westinghouse motor connected to a Root blower in one of the combination foundry sets which is complete on one base. These blowers are designed for a speed range of from one to one and a half to allow for a variation in the melt to be made as occasionally becomes necessary. For this purpose direct-current motors are better suited as they permit the desired changes in speed, should this be necessary. In other places where this variation in speed is not necessary, induction motors are used.

The capacity required in the motor is approximately 5 horse-power for every 1000 cubic feet of air required per minute at a pressure of 16 ounces, this being the average pressure which blowers are called on to produce, and an allowance of from 30,000 to 33,000 cubic feet of air is usually made to melt one ton of iron. Should a slight increase of pressure be necessary, the over-load capacity of the motor will handle this for a short time, which is one of the advantages of electric driving.

Personal*

Tom J. Nelligan, or information as to his whereabouts, is being sought by the National Machine Company, Milwaukee, Wis.

Fred Nolde, with the De La Vergne Machine Company, has recently been transferred from the Pittsburg to the New York office.

A. E. Mitchell, well known in railroad circles, has become vice-president of the Wyckoff Pipe and Creosoting Company, with offices at Stamford, Conn.

E. N. Percy, formerly engineer with the Atlantic Gulf and Pacific Company, has become assistant estimator with the Henry R. Worthington Company.

Wright Webb, until recently with the Westinghouse Machine Company, has been appointed manager of the Boston office of the Providence Engineering Works.

Herbert C. Petty was elected a director of the Crocker-Wheeler Company. Mr. Petty has been with the company for fifteen years and is at present contract manager.

Gordon S. Rutherford, connected with Solvay Process Company's branch at Detroit, has recently been transferred to the main plant at Syracuse, N. Y., and will give his attention to the caustic department.

Fred A. Geier, president of the Cincinnati Milling Machine Company, sails for Europe June 2, accompanied by his family. He expects to be abroad about four months, his trip being intended for pleasure only.

James C. Potter, president of the Potter & Johnston Machine Company, Pawtucket, R. I., sailed for an extended European trip. Mr. Potter expects to spend several months in England and on the continent.

S. E. Dauchy, formerly assistant superintendent of power and plant with the Yale & Towne Manufacturing Company, has become resident engineer for F. A. Waldron at the factory of the Ross Rifle Works, Quebec, Can.

A. W. Patterson, for some time connected with the engineering staff of the Ingersoll-Rand Company is now managing the Invincible Electric Renovator Sales Company, with headquarters in the De Graaf building, Albany, N. Y.

Richard H. Sears, who was for some time general sales manager of the Baush Machine Tool Company, has recently taken charge of the sales department of the Dean Alvord Company, large real estate and land developers in New York and vicinity.

Leroy A. Williamson has resigned his position with the Niles-Bement-Pond Company and is now associated with the Automatic Sealing and Stamping Machine Company, with offices at Providence, R. I. Mr. Williamson has been in ill health for some months, but is fast recovering.

E. Huhn, superintendent of Ludw. Loewe & Co.'s Works, Berlin, Germany, called at this office May 22. Mr. Huhn has spent about six weeks in this country, gathering information about machine-shop methods and making the acquaintance of machine-shop men. He sailed for home May 26.

James E. Gleason, of the Gleason Works, Rochester, N. Y., sails for Europe June 10. Mr. Gleason's trip is the outgrowth of the repeated calls by European representatives of American machine-tool builders for demonstrators of their machines, and his intention is to call upon the users of the products of the Gleason Works and see that they are fully informed regarding their possibilities.

*Items for this column are solicited.

Death of Gabriel Carlson

It has just come to our notice that Gabriel Carlson, inventor and factory superintendent of the Confectioners' Machinery and Manufacturing Company, met with a tragic and sudden death last month. Mr. Carlson possessed marked ability in inventing and developing many devices in confectionery machinery, and his career was brought to an end in the act of testing a machine, in which he was caught.

Business Items

The Izard-Warren Company, 1122 Vine street, Philadelphia, Penn., has been formed for the manufacture of transits, levels, drafting room outfits and supplies.

The Standard Separator Company has moved into its new concrete building, 274-282 Reed street, Milwaukee, Wis., which contains the latest modern equipment. The executive offices are at 79 Dearborn street, Chicago, Ill.

Boulet's Fine Tool Works, 55 Broadway, Beverly, Mass., has just been organized and equipped for the manufacture of Boulet's test indicators. They will also do general machine work and build special machinery. J. H. Boulet is the manager.

The Screw Machine Products Corporation, of Providence, R. I., has been formed and will further develop the feature of special order production of articles in steel, brass, german or sterling silver. The new corporation is an outgrowth of the Geo. W. Dover Company's department of screw machine products.

E. L. Essley and J. R. McDonald, formerly of McDowell, Stocker Company, Chicago, have organized the E. L. Essley Machinery Company, with main store at 67 West Washington street, Chicago, and branch office at Milwaukee, room 908, Majestic building. This company will buy and sell new and second-hand machinery.

The Pratt & Whitney Company, of Hartford, Conn., has decided to carry a full line of small tools and twist drills in stock again in Boston and has fitted up part of its warehouse at No. 265 Atlantic avenue in a very complete and convenient manner so that prompt shipment can be made. It has also on exhibition at the same place samples of its latest design turret lathes, thread millers, surface grinders, engine lathes, screw machines, etc. Catalog of full line will be furnished on request.

Trade Catalogs

The Electric Controller and Supply Company, Cleveland, Ohio. Bulletin No. 281 describing crane fittings. Illustrated, 24 pages, 5x7½ inches, paper.

The Lincoln Motor Works Company, Cleveland, Ohio. Bulletin No. 10, illustrating and describing variable speed motors. 16 pages, 8x10½ inches.

The J. Geo. Leyner Engineering Works Company, Littleton, Colo. Bulletin No. 514 describing sharpening machines, oil furnaces and coke furnaces. Illustrated, 24 pages, 6x9 inches, paper.

Jas. Clark, Jr., Electric Company, 313-315 West Main street, Louisville, Ky. Catalog of Willey electrically driven drills, grinders, hack saw, generators and motors. Illustrated, 62 pages, 10x11 inches, paper.

Business Opportunities

The Christie Iron Works, New York, will erect a new building.

The Nashville (Tenn.) Foundry Company is erecting a new building.

The Garland (Penn.) Nut and Rivet Company will build an addition to its plant.

The Clinton (Mass.) Wire Cloth Company will build an addition to its plant.

The Minneapolis (Minn.) Steel and Machinery Company will erect a $12,000 addition.

The Spuck Iron and Foundry Company, St. Louis, Mo., will erect an addition to plant.

The Butler (Ind.) Basket Company, whose plant was recently burned, has decided to rebuild.

The Fort Wayne (Ind.) Corrugated Paper Company will erect a plant to cost about $75,000.

The Fetzer Farm Implement Company, of Middletown, Ohio, will move its plant to Springfield.

The sash and door factory of Robertson & Hackett, Vancouver, B. C., was burned. Loss $75,000.

The Majestic Foundry and Machine Company, Huntington, Ind., is building a two-story addition.

The Beaver Dam (Wis.) Malleable Iron Company has awarded contract for the construction of a plant.

Two additions are to be made to the brass foundry of F. M. Macken and Company, Baltimore, Md.

The United States Stamping Company, Moundsville, W. Va., will erect a new factory at a cost of $30,000.

The plant of the John A. Bunn Chair Company, St. Paul, Minn., was destroyed by fire. Loss $50,000.

The Sterling Stone Company, of Pittsburg, Pa., is considering the establishment of a plant in Tulsa, Okla.

The Willex Manufacturing Company of Rome, N. Y., has been incorporated to manufacture gasolene and oil engines, etc.

W. W. Harrison and Son, Canton, Ill., are having a new blacksmith shop built which will be equipped with modern machinery.

A site has been selected by the Fraser Stove Works of Indianapolis at Anderson, Ind., and work on building will soon commence.

The Hohenstein-Hartmetz Furniture Company, Evansville, Ind., will soon erect a new plant on the site of the one recently burned.

It is stated that the Grand Trunk Railway will erect car shops at Barrie, Ont. W. D. Robb, Montreal, superintendent motive power.

The School Board of South Bend, Ind., will receive bids for the construction and equipment of a foundry and forge building at the Training School.

Burke & Gregory, Norfolk, Va., will build an additional printing plant to increase present capacity. New machinery to cost $45,000 will be installed.

A charter has been obtained by the Schuylkill & Dauphin Traction Company to build an electric railway. J. W. Mayor, of Pottsville, Pa., is secretary.

J. P. Paulson and Company, Salt Lake City, Utah, has commenced the erection of a $60,000 factory for the manufacture of office furniture, bar fixtures, etc.

Plans are being prepared by the Canadian Northern Ontario Railway Company for the erection of shops at Toronto. A. J. Hills, Toronto, is superintendent.

Baseler, Lawrence & Heineken, Philadelphia, Penn., will establish a plant in Havre de Grace, Md., for the manufacture of electrical switchboards, fixtures and supplies.

Plans have been approved by the Pennsylvania road for the enlargement of the Fort Wayne (Ind.) roundhouse and other improvements to cost about $500,000.

Construction of shops for the Idaho & Washington Northern Railroad at Spirit Lake, Idaho, will soon be commenced. These, with equipment, will cost about $200,000.

The plant of the Deibert & Wilson Textile Manufacturing Company, Elkton, Md., was destroyed by fire, causing a loss of $50,000. It is reported that it will be rebuilt.

The Texas Short Line will erect stations, repair shops, roundhouses, etc., on proposed branch from Comfort, Tex., to Fredericksburg. D. C. Earnest, Dallas, Tex., general manager.

The Hugo (Okla.) Implement Manufacturing Company, capitalized at $30,000, has contracted for the erection of a plant for the manufacture of hay presses, wagons and farm implements.

The B. A. Berger Manufacturing Company, Richmond, Va., has incorporated, and will install additional machinery in the present plant. The company manufactures a patented bracket and other metal articles used by plumbers.

The Arizona Southern Railroad Company has been incorporated in Minnesota to build a railroad in southern Arizona, capital, $100,000. Incorporators, A. A. Van Dyke, St. Paul, Minn.; J. A. Engelhard, Alexandria, Minn.; C. Van Dyke, Warren, Ariz.

The Gideon & North Island Railroad Company has been granted a charter to construct and operate a standard gage railroad about 12 miles long. Capital, $120,000. Incorporators, W. P. Anderson, M. S. Anderson, M. V. Mumona, of Gideon, Mo., and others.

The Champlain & Sanford Railroad Company has been incorporated with $600,000 capital stock to build a steam or electric railroad from Addison Junction to Sanford Hill, N. Y., a distance of 58 miles. Offices are in the Home Savings Bank building, Albany, N. Y.

The Springfield Armory, Springfield, Mass., are in need of the following supplies for the ensuing year: Twist drills, taps, files, wrenches, drill chucks, tool steel, electrical supplies, band saws, hack saw blades, materials for polishing and grinding, etc. Copies of proposal can be obtained of the commanding officer, Springfield.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Perfect factory space to let. Robt. J. Emory & Co., Newark, N. J.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Good second-hand boring mill, 24" swing. Give full description and price. Box 170, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia.

We are anxious to procure copies of August 25, 1904, issues of AMERICAN MACHINIST. Address, with price, Box 144, AMER. MACHINIST.

We are equipped to turn out twice the number of gears used on our own work, can we do yours to fill in? Samuel M. Langston, Camden, N. J.

The whereabouts of Tom J. Nelligan are respectfully requested. Address all communications National Machine Co., Milwaukee, Wis.

Shop in Massachusetts well fitted for electrical work desires machinery to build to order or by contract. Box 112, AMERICAN MACHINIST.

Valuable United States patent for sale outright or on royalty. The latest continuous blueprint machine. B. J. Hall, 41 Castelnau, Barnes, London, England.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—Some good specialty or new type of machine tool to manufacture in a modern plant, equipped with high grade tools and with ample capital. Box 151, AMER. MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinists take notice. Purchase castings and blueprints of high-grade gasolene motor, of world-wide reputation and at a profitable business. Write today. F. P. Conrad, 242 Freeport St., Harrison Sq., Boston.

We are looking about for some article or articles to take over. If you have something of merit, we will take up the financing, manufacturing and sale of it on any fair basis. "H. W. D.," AMERICAN MACHINIST.

New English Patent Law—We are open to manufacture all kinds of machinery in order to comply with the conditions of the above act. The Projectile Co. (1902), Ltd., New Road, Wandsworth Road, London, S. W., England.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

A German factory which as a specialty is building jigs or fixtures respectively for machines protected by patents in Germany and America, etc., is looking for representatives in the United States. All communications to be addressed under No. K. F., 1809, to Rudolf Mosse, Cologne.

Wanted—Machine builders who have a thoroughly up-to-date plant and abundance of capital (and none others) to build an automatic multiple spindle screw machine. Contract for term of years, machine exhibited in operation. Will do from two to four times the output of a single spindle. Is known of all over the world. Is handsome, strong, rapid and durable. Box 166, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

High-grade superintendent wants good position. Up in recent shop methods in all departments. Energetic, executive; a handler of help and a producer. Box 172, AM. MACHINIST.

ILLINOIS

Are you making the money you should be? Do you know where your weak spots are? Why not get a works manager or superintendent who has had experience hunting out these weak places, and applying the proper remedy? Experienced and practical manager of men is open for position. Can show past records which speak for themselves. If interested, look me up and see what past employers think of me. Box 169, AMERICAN MACHINIST.

MASSACHUSETTS

Experienced designer on automatic and special machinery. First-class references. Box 154, AMERICAN MACHINIST.

Wanted—Position as designing draftsman by a Swedish technical graduate; 27 years of age, with three years' experience in United States. Box 119, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Address Box 175, AMERICAN MACHINIST.

A young, up-to-date mechanic, with seventeen years' experience on tools, dies and experimental work; have held position as inspector and had charge. Would accept any position of trust. Box 171, AMERICAN MACHINIST.

NEW YORK

Salesman wishes position, experienced heating, sanitary and mechanical engineer. Box 164, AMERICAN MACHINIST.

Export—Business man seeks engagement with first-class manufacturer with view to acting later as salesman abroad. Has had four years' experience with large machine-tool importer in Europe, and is familiar with the English, French and German customs. Besides English, speak and write French and German. Address "Alpha," AMERICAN MACHINIST.

OHIO

Mechanical draftsman, technical graduate, expert in tool and machine designing, automatic machines, patent drawings, wants position. Box 163, AMERICAN MACHINIST.

WISCONSIN

Position as factory manager or general superintendent by thoroughly practical shop man. Interchangeable manufacture. Competent to take entire charge of factory and produce results. Replies desired only from those who want an A-1 man and who are willing to pay liberally therefor. Address Box 150, AMERICAN MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—A thoroughly capable working foreman. Must be experienced mechanic on brass

work, systematic, good executive ability. We manufacture storm fronts, brass finished, for automobiles. In Chicago; steady position, excellent opportunity for advancement for the proper man. Address with references, stating wages expected. Box 127, AMERICAN MACH.

MASSACHUSETTS

Wanted—We wish to add to our force, foremen, assembling and machine hands. Do not apply unless you have had experience in the manufacturing of monkey wrenches and similar work. Box 167, AMERICAN MACHINIST.

Machinist and tool-maker. Man especially familiar with spinning lathe work where high speed and rapid production are essential. Only first-class men need apply. Give experience and where obtained Box 165, AMER. MACH.

MICHIGAN

Wanted—Capable man of executive ability with practical knowledge of technical matters pertaining to boilers and machinery. Must be able to supervise small shops and handle technical and business correspondence. Box 173, AMERICAN MACHINIST.

Drop Forge Superintendent Wanted—One accustomed to steam and board drops, estimating costs, with a thorough knowledge of the business; no experimenters wanted. Fine opening to the right man. Address "Forger," care AMERICAN MACHINIST.

NEW JERSEY

Wanted—First-class chief draftsman, machine designing, with varied experience. State salary required. Windermuth, AMERICAN MACHINIST

NEW YORK

Wanted—First-class operator on Gridley, Cleveland and Acme automatic machines. State experience, age and wages expected. Box 168, AMERICAN MACHINIST.

Man experienced in all branches of sheet metal drawing and rapid production of sheet metal goods at low cost; must be able to make complete designs of suggested improvements. Address "Sheet Metal," care AMERICAN MACHINIST.

Wanted—General foreman for machine shop, 50 to 60 men, manufacturing special and automatic machinery, machine tools, etc. Must be thorough mechanic, familiar with modern methods, and have the right personality and push to produce results at minimum costs. Good opportunity and future for right man. Address, with full particulars, stating experience, references, age, nationality and salary expected. Box 162, AMERICAN MACHINIST.

PENNSYLVANIA

Draftsman, to have charge of department containing five men. One familiar with hoisting and conveying machinery preferred. Box 161, AMERICAN MACHINIST.

Draftsman—Competent man on small interchangeable work. Good steady position for reliable man. State age, experience and salary desired. Elliott-Fisher Company, Harrisburg, Penn.

Wanted, by a concern engaged in the manufacture of textile machinery, a first-class man to visit the trade. Must have experience in the textile industry. Knowledge of the German language desirable. State age, experience and salary expected. P. O. Box 840, Reading, Penn.

RHODE ISLAND

Wanted—A man with an all around repair experience to take position as master mechanic in large manufacturing establishment in New England. Experience in textile work preferred. State education, experience, age, nationality and references. Box 174, AMERICAN MACHINIST.

For Sale

For Sale—One second-hand Uehling Steinbart & Company pneumatic pyrometer complete, with recording gage. Box 140, AMER. MACHINIST.

For Sale—Machine shop equipped to handle 12 men in Brooklyn. Worth $5000, selling price $3000, part cash. Write Max Corin, 200 Broadway, New York.

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Carborundum Co., Niagara Falls, N. Y.
Dickinson, Thos. L., New York.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Agents, Foreign Machinery

C. I. F. Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Balancing Ways

Bowsher Co., N. P., South Bend, Ind.

Barrels, Steel

Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling

Globe Machine & Stamping Co., Cleveland, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller

Boston Gear Works, Norfolk Downs, Mass.
Hyatt Roller Bearing Co., Harrison, N. J.
Iroquois Machine Co., Providence, R. I.
Iroquois Mach. Co., Providence, R.I.

Belt Dressing

Cling-Surface Mfg. Co., Buffalo, N.Y
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Fasteners

Bristol Co., Waterbury, Conn

Belt Filler

Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belt Shifters

The L. & D. Co., Boston, Mass.

Belting, Leather

Chicago Raw Hide Mfg. Co., Chicago, Ill.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Benches, Work

Manufacturing Equipment & Engineering Co., Boston, Mass.

Bending Machinery, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machinery, Plate

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machinery, Power

Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chains

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Blocks, Die

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Blowers

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Brothers & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Davis Machine Co., W. P., Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Manville Mach. Co., E. J., Waterbury, Conn.
McCabe, J. J., New York.
Milton Mfg. Co., Milton, Pa.
Mummert, Wolf & Dixon Co., Hanover, Pa.

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National-Acme Mfg. Co., Cleveland, O.
National Machinery Co., Tiffin, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads

Lang & Co., G. R., Meadville, Pa.

Bolts and Nuts

Milton Mfg. Co., Milton, Pa.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Mindletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Hill Publishing Co., New York.
Longmans, Green & Co., New York.
Sames, Chas. M., Jersey City, N. J.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.

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Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.

Boxes, Tote

Lyon Metallic Mfg. Co., Aurora, Ill.

Box Tools, Roughing

Bardons & Oliver, Cleveland, O.

Brazing

Industrial Oxygen Co., New York.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Providence, R.I
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum

See Grinding Wheels.

Carborundum Paper and Cloth

Carborundum Co., Niagara Falls, N. Y.

Case-Hardening

American Gas Furnace Co., New York.
Rogers & Hubbard Co., Middletown, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Castings, Brass and Bronze

Clum & Atkinson, Rochester, N. Y.
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded

Berry & Parker, Erie, Pa.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cell Drier Machine Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Taylor & Fenn Co., Hartford, Ct.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Mass.
Cammel, Laird & Co., New York.

Cast Iron Brazing

Industrial Oxygen Co., New York.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.
Obermayer & Co., S., Cincinnati, O.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

Chisels, Cold

Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Wks Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H. New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Lancaster Knife and Machine Wks. Lancaster, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cincinnati Chuck Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.

Chucks, Lathe—*Continued.*

Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Harrington & Son Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn
Niles-Bement-Pond Co., New York
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Hammacher, Schlemmer & Co., New York.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Starrett Co., L. S., Athol, Mass.
Tudor Mfg. Co., Taunton, Mass.
Williams & Co., J. H., Brooklyn, N. Y.

Clocks, Watchman's

Hardinge Bros., Chicago, Ill.

Clutches, Friction

Bliss Co., E. W., Brooklyn, N. Y.
Caldwell, Son & Co., W. H., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Williams Foundry & Machine Co., Akron, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Compound, Core

Obermayer Co., S., Cincinnati, O.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Machine Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Blaisdell Machinery Co., Bradford, Pa.
Ingersoll-Rand Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Mach. Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York

Corundum

See Grinding Wheels.

Cotters

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Revolution

Root Co., C. J., Bristol, Conn.
Schuchardt & Schutte, New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Ohio
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Couplings

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Williams Fdry. & Mach. Co., Akron, Ohio.

Cranes

Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Franklin Port. Crane and Hoist Co., Franklin, Pa.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa

Cranes—*Continued.*

Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas and Ladles, Foundry

Obermayer Co., S., Cincinnati, O
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M.; Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Armstrong Bros. Tool Co., Chicago Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

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Dickinson, Thos. L., New York.
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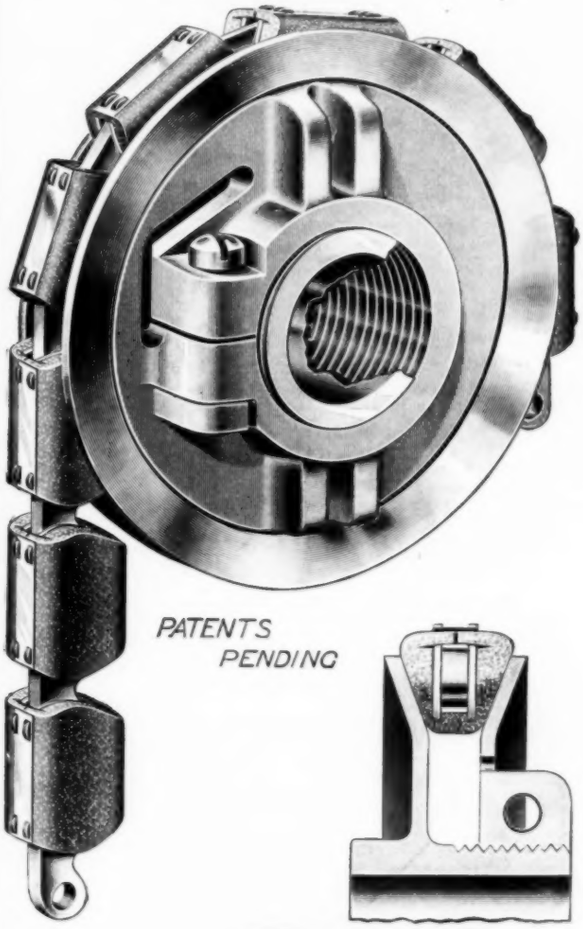
For Cooling Fans, Oiling Devices, Motorcycles, Etc.



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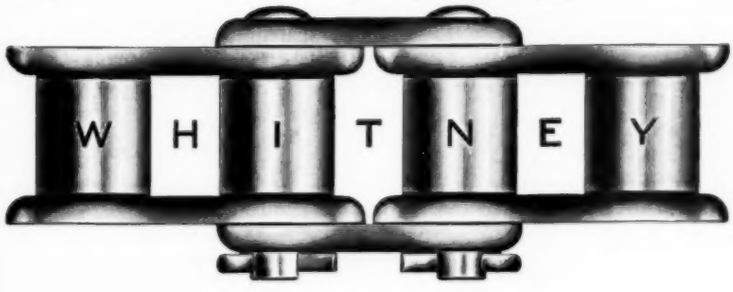

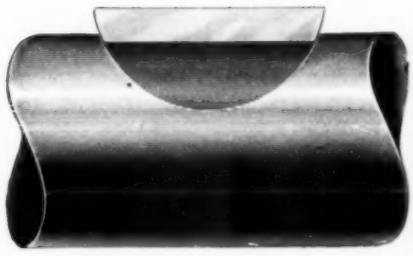

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Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

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Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass,

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Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

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Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

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Allen Co., Chas. G., Barre, Mass.
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Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Co., Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Mach. Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
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Prentice Bros. Co., Worcester, Mass.
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Slate Machine Co., Dwight, Hartford, Conn.
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Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

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Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

Drills, Flat

Whitman & Barnes Mfg. Co., Chicago, Ill.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

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Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Rail

Foote-Burt Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
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Western Electric Co., Chicago, Ill.
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Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincinnati, O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
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Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Cincinnati Electrical Tool Co., Cincinnati, O.
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Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Electrically Driven Tools and Machinery—*Continued.*

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See Grinding Wheels,

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
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Vitrified Wheel Co., Westfield, Mass.
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Hart & Cooley Co., New Britain, Conn.

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Lunkenheimer Co., Cincinnati, O.

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Merritt, Jos., Hartford, Conn.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
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Grant Mfg. & Mach. Co., Bridgeport, Conn.

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Franklin Mfg. Co., H. H., Syracuse, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Engines, Steam

Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

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Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

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Nicholson & Co., W. H., Wilkes Barre, Pa.

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C. I. F. Co., New York.

Eyelet Machinery

Manville Bros. Co., Waterbury, Conn

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Eng. Co., Boston, Mass.

Fans, Electric

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

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Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
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Reichhelm & Co., E. P., New York
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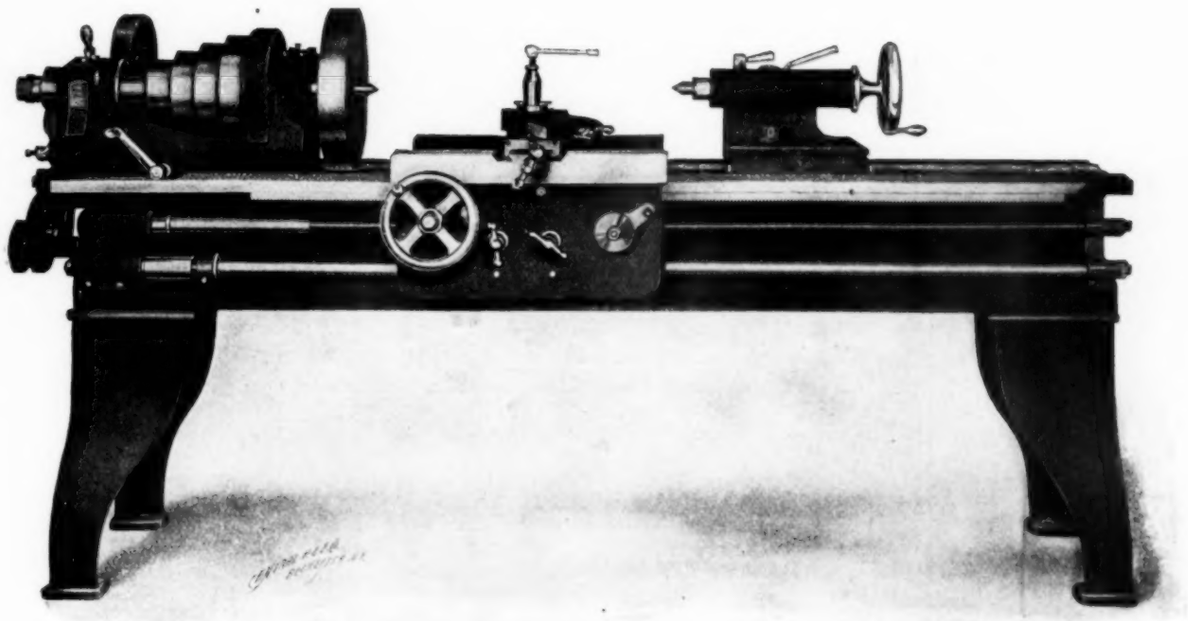

DAVIS 16-INCH ENGINE LATHE
With Quick Change Feed.

The above cut represents our latest model of 16" Engine Lathe which is the same general design as our 14 and 18-inch lathes, except that we use a five step cone on both the 16 and 18-inch lathes, they are of more massive design, and intended for the heaviest class of work that is to be done on this size of lathe.

Our 16-inch lathe as illustrated, is designed for general machine work and tool room use, it is an accurate well made tool, and its special feature is the Quick Change Feed, in making the change for a given thread to be cut, but one gear has to be changed, and this change can be made in from 15 to 30 seconds.

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Orders can be sent to us direct or through leading machinery dealers in all large cities of the world.

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Bradley & Son, C. C., Syracuse, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
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Sturtevant Co., B. F., Hyde Park, Mass.

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Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
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Williams & Co., J. H., Brooklyn, N. Y.

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Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

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Tate, Jones & Co., Pittsburg, Pa.

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Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn

Gages, Standard
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.

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Pratt & Whitney Co., Hartford, Conn.
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Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam
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Crosby Steam Gage & Valve Co., Boston, Mass.

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American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnat Shaper Co., Cincinnati, Ohio.
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Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

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Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, Mass.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa
Sawyer Gear Works, Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y

Gears, Molded—*Continued.*
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co, McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. P., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cutter
Bath Grinder Co., Inc., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Toool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disc
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis
Heald Mach. Co., Worcester, Mass.
Iroquois Mach. Co., Providence, R.I.
Safety Emery Wheel Co., Springfield, Mass.
Taylor & Fenn Co., Hartford, Conn.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Mormon Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Knife
American Wood Working Mchy. Co., Rochester, N. Y.
Safety Emery Wheel Co., Springfield, O.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
U. S. Electrical Co., Cincinnati, Ohio.

Grinders, Saw
Tindel-Morris Co., Eddystone, Pa.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Providence, R.I.
Landis Tool Co., Waynesboro, Pa.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc. Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
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Vitrified Wheel Co., Westfield, Mass
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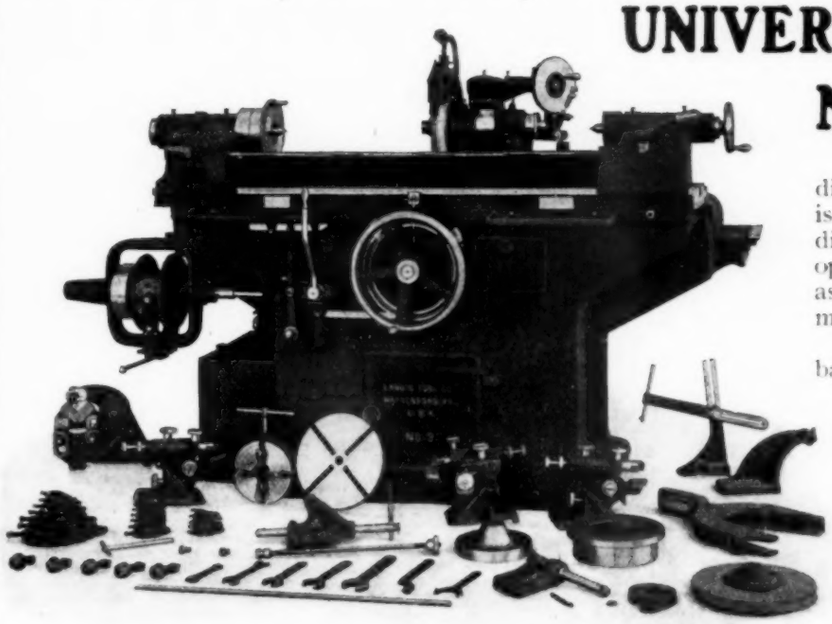
A FEW DIMENSIONS OF OUR No. 3 LANDIS UNIVERSAL GRINDING MACHINE



This machine has swing of 12" diameter, is 42" between centers and is a tool adapted for use in many difficult grinding and sharpening operations in the tool room as well as being an excellent machine for manufacturing purposes.

The headstock is composed of base and swivel. This swivel is graduated to 90 degrees and carries the headstock spindle which is 2⅝" diameter. On the front end of this spindle can be screwed the regular face plate or chuck and work when held by this face plate or chuck can be face ground to any angle.

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Bench Miller

For Fast, Accurate Tool Room Work

Travels: Vertical 7", Longitudinal 10", Transverse 4¾", Weight 308 pounds.

Collets, arbors, etc., are interchangeable with those of our No. 5½ Bench Lathe. There is no better tool made.

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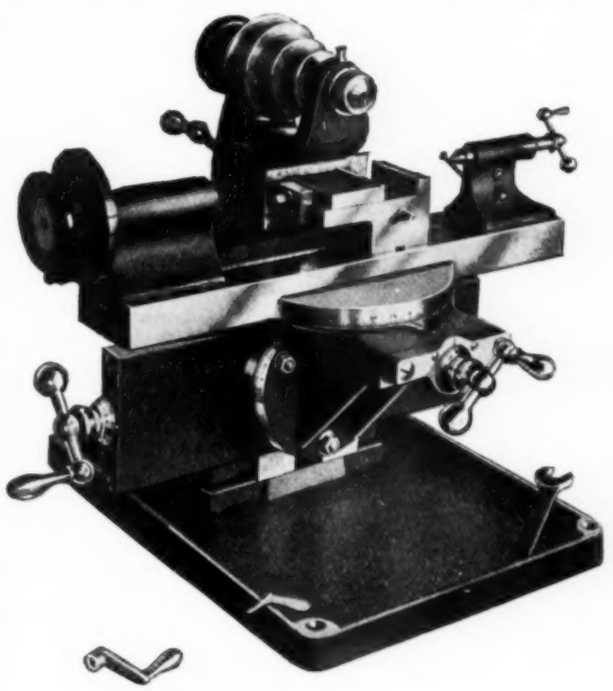

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Crocker-Wheeler Co., Ampere, N. J.
Diamond Machine Co., Providence, R. I.
Gardner Mach. Co., Beloit, Mich.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Iroquois Mach. Co., Providence, R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
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Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
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Pittsburg Emery Wheel Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
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Safety Emery Wheel Co., Springfield, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
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Adams Co., Dubuque, Iowa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Machine Co., Providence, R. I.
Dickinson, Thos. L., New York.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
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Norton Co., Worcester, Mass.

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Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Hammers, Drop

Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Iroquois Mach. Co., Providence, R. I.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Hammers, Power

Bradley & Son, C. C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Hammers, Steam

Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

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Manville Mach. Co., E. J., Waterbury, Conn.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Chicago Flexible Shaft Co., Chicago, Ill.

Hobbing Machines, Worm

Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Ct.
Schuchardt & Schutte, New York.

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Brown Hoisting Machinery Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Port, Crane and Hoist Co., Franklin, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Link-Belt Co., Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Electric

C & C Electric Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Case Mfg. Co., Columbus, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Hones

Carborundum Co., Niagara Falls, N. Y.

Hose, Air

Independent Pneumatic Tool Co., Chicago, Ill

Igniters, Gas Engine

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Indicators, Speed

Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine

Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test

Grant Mfg. & Mach. Co., Bridgeport, Conn.
Norton Grinding Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Industrial Engineers

Woods & Co., Clinton E., Brooklyn, N. Y.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Inspection and Tests

Hunt Co., Robert W., Chicago, Ill.

Iron Bar

Milton Mfg. Co., Milton, Pa.

Jacks, Hydraulic

Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Jacks, Lever and Screw

Watson-Stillman Co., New York.

Kettles, Soda

Brown & Sharpe Mfg. Co., Providence, R. I.
Mfg. Equip. & Engineering Co., Boston, Mass.

Key Seaters

Baker Bros., Toledo, O.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Lapointe Mach. Tool Co., Hudson, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Morton Manufacturing Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Conn.

Knives, Machine

Coes Wrench Co., Worcester, Mass.
Lancaster Knife and Mach. Wks., Lancaster, N. Y.
Simonds File Co., Fitchburg, Mass.

Lamps, Arc

General Electric Co., New York.
Turner Brass Works, Sycamore, Ill.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa

Lathe Attachments

American Tool Works Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
LeBlond Machine Tool Co., R. K., Cincinnati, Ohio.
Mossberg Wrench Co., Central Falls, N. Y.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Sebastian Lathe Co., Cincinnati, O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Tindel Morris Co., Eddystone, Pa.
Williams & Co., J. H., Brooklyn, N. Y.

Lathes

American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.

Lathes—*Continued.*

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Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cincin., O.
Bridgeford Mach. Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Champion Tool Works Co., Cincinnati, O.
Cincinnati Lathe and Tool Co., Cincinnati, O.
Colcord Mchry. Co., W.R. St. Louis, Mo.
Davis Machine Co., W. P., Rochester, N. Y.
Dreses Mach. Tool Co., Cin., O.
Fay Mach. Tool Co., Phila., Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mach. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.
Fay Machine Tool Co., Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench

American Watch Tool Co., Waltham, Mass.
Ames & Co., B. C., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sebastian Lathe Co., Cincinnati, O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Waltham Machine Works, Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

American Wood Working Mchry. Co., Rochester, N. Y.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass

Bardons & Oliver, Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, O.